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Apex Site
Final Engineering Report
for
Pond 2 Closure Plan
Volume II
Specifications and Drawings

Prepared for:

Hecla Mining Company
6500 Mineral Drive, Suite 200
Coeur d'Alene, Idaho 83815-8788

Prepared by:

Monster Engineering Inc.
3031 Bonner Spring Ranch Road
Laporte, Colorado 80535

March 25, 2004



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VOLUME II

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1.0 Introduction

1.1 General

These Specifications are for the Final Closure Plan for Hecla Mining Company's Pond 2 at the Apex Site near St. George, Utah. The Work consists of all construction associated with implementation of the Closure Plan and completion of the closure of Pond 2. The Work is to be performed for Hecla Mining Company hereinafter referred to as the Owner. The Work is in general divided into three separate phases:

- ▶ Phase 1 - Waste Material Drainage and Consolidation
- ▶ Phase 2 - Impoundment Regrading
- ▶ Phase 3 - Final Cover System Construction

1.2 Background

The Apex Site is located approximately 15 miles northwest of St. George, Utah on land leased from the Shivwits Band of the Paiute Tribe. The Site can be accessed through the OMG facility on which it is located. A security fence surrounds the site.

The Apex Site encompasses a total area of approximately 8 acres. Pond 2 (the impoundment) is a synthetically-lined waste containment facility which is roughly circular with an area of approximately 5 acres. The lining consists of a fabric-reinforced spray-on asphaltic membrane approximately one quarter (1/4) to one half (1/2) inch in thickness. Hecla removed and disposed a variety of on-site materials into Pond 2 as part of a site cleanup in agreement with OMG in 1995. Materials currently in the impoundment include:

- ▶ gallium and germanium extraction process wastes (solutions and solids)
- ▶ cobalt-sulfate recovery process wastes
- ▶ ore stockpile materials
- ▶ old impoundment liner materials
- ▶ subsoils

Some of these materials were mixed with lime and limestone prior to disposal, while others were dredged and pumped into the impoundment as a slurry. During site cleanup Work, the perimeter embankment was raised approximately five feet (5') to provide sufficient capacity for material disposal. The embankment raise was constructed utilizing on-site soils (clay to cobble sizes) over the centerline of the existing embankment. The raise was unlined and the crest is approximately ten feet (10') wide. The embankment ranges from three feet (3') to seven feet (7') above the existing ground surface with outslopes that range from approximately 2:1 (H:V) to 3:1. Currently the impoundment has a temporary rock and topsoil cover which is approximately two (2') to four and one-half (4½') feet thick.

1.3 Description of Work

These Specifications address all Work at the Site. The Work is generally divided into the following activities:

- ▶ management of storm water, sediment and dust
- ▶ drainage and consolidation of waste materials within the impoundment
- ▶ burial of additional on-site wastes, removal of a portion of the existing embankment, regrading of temporary cover and embankment materials on the top surface
- ▶ rebuilding of the embankment and construction of the final cover system
- ▶ excavation of a diversion channel around the reclaimed impoundment and erosion protection placement

1.3.1 Storm Water Management, Sediment and Dust Control

Storm water and sediment management structures will consist of silt fences, straw bales, ditches, and containment berms. Silt fences and straw bales will be constructed at the downstream side of all excavation areas within the project boundary. Ditches and containment berms will be constructed to segregate runoff from the impoundment from that originating in undisturbed or other borrow areas. Locations of all structures will be subject to approval by the Owner's Rep.



All exposed and disturbed construction areas will be sprayed with water on a regular basis using a water truck. Construction roads and the borrow area will also be periodically sprayed with water to minimize dust production. Depending on climactic condition, all Work areas including borrow areas, haul roads, and general traffic areas will be sprayed with water at the end of each working day.

1.3.2 Waste Material Drainage and Consolidation (Phase 1)

Work to be completed in this phase consists of draining and evaporating free liquids within the waste materials. Settlement of the top surface of the impoundment will be measured with installed settlement monuments. Liquids emitting from the waste materials / wick drains will be managed with temporary fluid containment berms to maximize evaporation rates. Construction of the final cover system will begin when the Engineer has determined that overall settlement has slowed to an acceptable rate. Collection ditch and evaporation pond materials will be excavated and buried within the impoundment.

1.3.3 Impoundment Regrading (Phase 2)

Impoundment regrading will involve removal of a portion of the existing impoundment perimeter embankment. This material will be utilized as additional temporary cover material for the top surface and will assist with drainage and consolidation of the waste materials. Depending on the amount of fluids produced through the wick drains and the evaporation rate (fluid management and weather), this phase will most likely be incremental, with certain areas of the impoundment accessible sooner than others. The objective of the regrading is to achieve final impoundment configurations prior to Phase 3 (Final Cover System Construction).

1.3.4 Final Cover System Construction (Phase 3)

Final cover system construction will consist of placing the three separate material layers on the impoundment and reconstructing the impoundment embankment. The three layers consist of:

- ▶ a geosynthetic clay liner Barrier Layer (GCL)
- ▶ an on-site soils Protection Layer
- ▶ a rock erosion Surface Layer on the impoundment out slopes.

Protection Layer and embankment reconstruction soils will originate from the excavation / construction of the surface water diversion channel.

1.3.5 Surface Water Diversion Channel Construction

The diversion channel will be constructed as shown on the Drawings to the east of the reclaimed impoundment. Erosion protection will be placed at the west side of the diversion channel where it intersects the east side of the impoundment.

1.4 Definitions

The following definitions apply to these Specifications and Drawings:

- ▶ Owner - is an authorized representative of Hecla Mining Company
- ▶ Construction Quality Assurance Engineer (CQA Engineer) - qualified representative appointed and authorized by the Owner to monitor the quality of the completed construction product
- ▶ Engineer - authorized representative of the Owner who has designed the facilities to be constructed and prepared the Specifications and Drawings
- ▶ Owner's Representative - qualified Construction Manager or Engineer appointed and authorized by the Owner to provide third-party oversight during the construction process
- ▶ Contractor - the party or parties which have a contract agreement with the Owner and perform actual construction activities
- ▶ Specifications - this document of Technical Specifications prepared by Monster Engineering Inc., for the Apex Project, dated August 2003.
- ▶ Drawings - the drawings to be read in conjunction with these Specifications are titled, "Plans for Construction Apex Pond 2 - Final Reclamation"
- ▶ In-place material - soil or rock material existing within a particular construction area



- ▶ New Work areas - undisturbed areas or areas where clearing, grubbing, and or stripping has not previously been performed
- ▶ Borrowed material - material obtained from sources other than in-place that is transported to the construction areas
- ▶ All slopes are described in terms of horizontal distance:vertical distance.
- ▶ All sieve sizes refer to U.S. Standard sieve sizes.
- ▶ Where discrepancies between these Specifications, Drawings, scope of Work and bid documents occur, the more stringent interpretation or requirement will apply.

1.5 Submittals

1.5.1 Description

- A. The Contractor shall be responsible for submitting all submittals to the Engineer; checking submittals prior to submission to the Engineer; verification of field instruments, field construction criteria, catalogue numbers and similar data; and ensuring each item submitted clearly shows the Project Name and Title.
- B. Contractor's responsibility for errors and omissions in submittals is not relieved by the Engineer's review of submittals.
- C. The Contractor shall submit sufficiently early to provide adequate time for reviews, possible corrections and re-submittals, placing orders, securing delivery and to avoid construction delays.
- D. The Contractor shall accompany each submittal with a letter of transmittal containing all pertinent information required for identification and review of submittals. When submittals are resubmitted for any reason, transmit each re-submittal under a new letter or transmittal.
- E. Contractor shall not perform any part of the Work until the submittals for same have been reviewed by the Engineer.

1.5.2 Samples

- A. Before delivery of materials to the Site, the Contractor shall submit samples of materials as required by section of the Specifications and as requested by the Engineer. Contractor shall label samples as to origin and intended use in the Work and in accordance with the requirements of section of the Specifications. The Contractor shall ensure samples represent physical examples to illustrate materials, equipment or workmanship, and to establish criteria by which completed Work is judged.
- B. The Contractor shall ensure samples are of sufficient size and quantity, if not otherwise specified, to illustrate the quality and functional characteristics of product or material with integrally related parts and attachment devices, and color.
- C. The Contractor shall construct field samples and mock-ups on the Site at locations acceptable to the Engineer. Construct each sample or mock-up complete, including work of all trades required in finished Work.

1.5.3 Shop Drawings

- A. The term "shop drawings" means drawings, diagrams and other data which are provided by the Contractor to illustrate details of portions of the Work.
- B. The Contractor shall prepare shop drawings consistent with the Drawings in presentation, arrangement, and details where the latter are shown. Contractor shall prepare shop drawings in a manner which the Engineer considers necessary to show details of the Work to be performed. Contractor shall clearly identify each shop drawing by title and number of the Contract, and reference to applicable Contract Drawings.
- C. The Contractor shall ensure design information, calculations, and shop drawings required by Specifications or which are final drawings within the meaning of intent of applicable legislation relating to professional engineering in the jurisdiction in which project Site is located are sealed and signed by a registered professional engineer.
- D. The Contractor shall submit, in time to suit the Contract Schedule, not less than six (6) copies



- of shop drawings to the Engineer for Review. One (1) of the copies will be returned by the Engineer, stamped to indicate that the shop drawing has been reviewed and comments added where applicable. If shop drawings are illegible, obscure, or incomplete, they will be returned by the Engineer marked "not reviewed". Contractor shall redraw and resubmit shop drawings.
- E. The Contractor shall make corrections in shop drawings which the Engineer may require consistent with the Contract, and resubmit as before. When the Engineer's review is complete and requested corrections made, Contractor shall provide four (4) copies of certified drawings incorporating requested corrections, for the use of and distribution by the Engineer. Contractor shall ensure Work and units supplied conform to final drawings which must have the following notation:

Certified for Construction

Signature: _____

Date: _____

- F. The Contractor shall ensure the certification is signed by a Professional Engineer certified to carry out such practice in the State where the Work is to be performed.
- G. The Engineer's review of shop drawings is for the sole purpose of ascertaining conformance with the general arrangement, but no approval is given or responsibility assumed by the Engineer for the detail design inherent in the shop drawings or for corrections of dimensions or details or conformity to specification, which remain the responsibility of the Contractor submitting same.
- H. The Contractor shall supply drawings, templates, and special instructions as called for in the Specifications, and as required for the proper installation of the parts shown and in accordance with the intent of the Proposal Documents.

1.5.4 Product Data

- A. The term "product data" means schematic drawings, catalogue sheets, diagrams, illustrations, brochures, manufacturer's instructions and other data provided the manufacturer to illustrate details of a portion of the Work.
- B. The Contractor shall modify schematic drawings if and as necessary to ensure they show all and only the information applicable to the Work.
- C. On the catalogue sheets, diagrams, illustrations, brochures and other data, Contractor shall clearly mark each copy to identify materials, products or models applicable to the Work. Contractor shall show dimensions, clearances, performance characteristics, capacities, wiring diagrams and controls applicable to the Work.
- D. The Contractor shall submit four (4) copies of product data and manufacturer's instruction to Owner's Representative when required to supplement the Specifications for the assembly and installation of specific products.
- E. The Contractor shall provide copies of such approved data and instruction to each work crew working on the items affected.
- F. Product data and manufacturer's instructions only apply to particular requirements relative to the manufacturer's products and are in addition to the Specifications. Contractor shall not interpret or apply such instruction to limit the Work or responsibilities. The Proposal and Contract Documents take precedence in case of conflict. Contractor shall inform the Engineer promptly in writing in the event of such conflict.

1.5.5 Test Reports and Certificates

- A. The Contractor shall submit three (3) copies of each test report and each certificate to the Owner's Representative.
- B. The Contractor shall ensure each test report clearly shows:
1. Project Name
 2. Contract Number



3. Contract Title
4. Contractor's Name
5. Date of Test
6. Purpose of Test
7. Results of Test
8. Codes and Standards used for Test
9. Company or party making the Test
10. Company or party making the Report

1.5.6 Work Progress Schedule

- A. Scope: The Work specified in this subsection includes planning, scheduling, and reporting that is required to be performed by the Contractor.
- B. Method: A critical path or bar graph type schedule, fully man-loaded and prepared per each Contract item, shall be submitted with the Contract. Upon Owner review comments, the critical path schedule will be resubmitted to Owner within seven (7) calendar days after the effective date of the agreement.
- C. Schedule Requirements:
 1. Distinct items of contract works shall be defined and separated on the schedule. As a minimum, the work items shall include each contract pay item, mobilization, demobilization, and cleanup. Pay items that are partially subcontracted shall be split up to distinctly show the subcontracted work. These items of Work shall be plotted on a graph with calendar days duration as a horizontal reference. Anticipated start and finish dates for each Work stage and for each of the Work items within a stage, shall be shown.
 2. The project name, the Contractor's name, and the date of the submittal.
- D. Progress Reports:
 3. At the end of each week, the Contractor shall submit a summary report of the progress of the various scheduled Work items stating, for each item, the existing time status, estimated time of completion, and cause of delays, if any. If the Work is behind the previously submitted schedule, the Contractor shall submit an updated schedule and a written plan acceptable to the Owner for bringing the Work up to schedule.
 4. Updated schedules will be used by the Owner in compiling partial payments and no such computations will be made until the reports have been received and approved by the Owner.
 5. The Owner may request reports to be made on a more frequent schedule if he considers the substantial completion date to be in jeopardy because of activities behind schedule or for other valid reasons.

1.5.7 Certification of Tradesmen

The Contractor shall provide certificates to prove qualifications of personnel employed on the Work where such certification is required by authorities having jurisdiction, or by the Contract Documents.

1.5.8 Warranties

The Contractor shall submit warranties showing the project name and the contract number and title, warranty commencement data and duration of warranty. Contractor shall clearly indicate what the warranty covers and what remedial action shall be taken under the warranty. The Contractor shall ensure warranty bears the signature and seal of the Contractor.

1.5.9 Survey Data

The Contractor shall submit weekly to Owner a list of control points used for constructing the Work during that week. List of control points shall include mini-grid coordinates and elevations.

1.5.10 Geosynthetic Clay Liner Record Drawing

The GCL installation contractor shall provide scaled As-Built layout drawings on reproducible mylar



documenting the as-constructed panel and roll locations, at a suitable scale for presentation on 24-inch by 36-inch standard size drawings. The As-Built drawings are required to be drafted and of professional quality for approval by Engineer.

1.6 Quality Assurance

1.6.1 Description

This Section defines the project Quality Assurance requirement provided by the CQA Engineer. The CQA Engineer will be responsible for all quality assurance testing as outlined in this Specification and as indicated by the Owner, unless otherwise noted in the Specifications or the Drawings.

1.6.2 Construction Quality Assurance (CQA)

The CQA Engineer will maintain an effective CQA program. The CQA program will encompass all actions involving selection of construction material sources and on-site and off-site production of construction materials, work placement procedures, workmanship, monitoring, and testing.

1.6.3 CQA Testing and Frequency

CQA tests and frequency are discussed throughout the Specifications. The frequencies indicated are minimums only, and do not include retests of failed materials. Those CQA tests and testing frequencies to be conducted in the field by CQA Engineer are included in Table 1.1 and in the Specifications. Table 1.2 summarizes earthworks material specifications.

1.6.4 Quality of Materials and Labor

All materials used on this Contract shall be new and the best market quality, unless specified or shown otherwise. All labor on this contract shall be competent and skilled for the Work. All Work executed under this Contract shall be done in the best, most thorough, substantial and workmanlike manner. All material and labor shall be subject to the approval of the CQA Engineer as to quality and fitness, and shall be immediately removed if it does not meet with this approval. The Owner or the Owner's Representative may refuse to issue any certificate or payment until all defective materials or Work have been removed, and other material of proper quality substituted thereof.

1.6.5 Contractor's Responsibilities

- A. The Contractor is responsible for the quality of the Work of the Contract.
- B. The Contractor shall make good all Work for which any test result indicates the Work does not conform to the requirements of the Contract. Deem such Work to be condemned by the Engineer as in Article 9 of the General Conditions.
- C. The Contractor shall certify that all equipment used in the Work is in accordance with the provisions of the Contract. Certification does not relieve Contractor's responsibility for providing satisfactory materials, equipment, and workmanship.
- D. Any inspection and/or testing done for or on behalf of the Contractor shall not relieve the Contractor from any responsibility for the quality of the Work.
- E. The Contractor shall be aware of all CQA testing activities and shall account for those activities in the construction schedule.
- F. The Contractor shall be responsible for cooperating with the CQA Engineer during all testing activities. The Contractor shall provide equipment and labor to assist the CQA Engineer in sampling, if requested, and shall also provide access to all areas requiring testing activities.

1.6.6 Inspection Schedule

- A. The regraded temporary cover surface shall be jointly inspected by design and construction engineers, and GCL installation Contractor, and approved before deployment of GCL will be permitted.
- B. Inspection of excavation of existing embankment materials will be continuous.
- C. Inspection of GCL materials during placement will be continuous.



Specification Table 1.1 CQA Testing Frequency			
Material	Test	Minimum Test Frequency ²	
		Suggested Time Interval	cy/test
1. Borrow ¹			
1.1 General Fill Materials: Temporary Cover Materials Existing Embankment Materials General Earth Fill	Grain Size	1 per day	4,000
	Compaction	1 per day	4,000
1.2 Protection Layer Materials	Grain Size	2 per day	2,000
	Compaction	1 per day	4,000
	Atterberg Limits	1 per day	4,000
	Moisture Content	2 per day	2,000
1.3 Erosion Protection	Gradation	NA	100
2. Constructed Facility			
2.1 Regraded Temporary Cover (subgrade): Temporary Cover Materials Existing Embankment Materials General Earth Fill	In-place moisture and density	2 per day	2,000
2.2 Embankment (General Earth Fill)	In-place moisture and density	2 per day	1,000
2.3 Barrier Layer (GCL)	visual observation	continuous	NA
2.4 Protection Layer (General Earth Fill)	In-place moisture and density	2 per day	2,000
2.5 Surface Layer (Erosion Protection)	visual observation	continuous	NA

- Notes:
1. Perform all tests when borrow material characteristics change, or 1 per day, whichever is greater.
 2. Presented as a guide to QC monitors. Testing frequency may be higher due to material availability. Similarly, the testing frequency of the index tests, i.e., Atterberg, Grain Size, and Gradation, may be decreased should material uniformity support a lower testing frequency. Specified time interval testing frequencies are for continuous construction activities, and should be modified accordingly for those tasks where construction is intermittent. The testing frequency of tests per cubic yard shall govern frequency.



**Specification Table 1.2
Earthworks Specifications Summary**

Constructed Feature	Fill Type	Gradation		Maximum Loose Lifts	Moisture Content	Compaction
		Sieve Size	% Passing (by wt.)			
Temporary Cover	Temporary Cover	NA	NA	1 foot	NA	90% ASTM D698 or minimum 4 passes w/ smooth-drum, vibratory compactor ≥ 10 tons
	Existing Embankment	NA	NA	1 foot	NA	90% ASTM D698 or minimum 4 passes w/ smooth-drum, vibratory compactor ≥ 10 tons
	General Earth	4 inch	100	1 foot	NA	90% ASTM D698
Embankment	General Earth	4 inch	100	1 foot	NA	90% ASTM D698
Barrier Layer	GCL	NA	NA	NA	NA	NA
Protection Layer	General Earth	2 inch	100	1 foot ¹	NA	Use LGP ² Equipment 85% ASTM D698 ³
Surface Layer	Rock	D ₅₀ = 1"	NA	2" ⁴	NA	NA
Diversion Channel	Rock	D ₅₀ = 3"	NA	6" ⁴	NA	NA

- Notes:
- 1 foot loose lift minimum thickness to protect GCL (Barrier Layer).
 - LGP = Low Ground Pressure
 - Maximum compaction of 85% ASTM D698 - no heavy equipment on Protection Layer until final grading being conducted
 - Required layer thickness



2.0 General Excavation, Backfilling, and Compaction

2.1 General

2.1.1 Description

- A. This item shall include, but is not limited to, site preparation, clearing and grubbing, excavation, selective stockpiling of soils for earthwork related to excavation, rock and general fill placement, subgrade preparation for Geosynthetic Clay Liner (GCL), and anchor trench excavation.
- B. The Work includes furnishing all labor, tools, materials, equipment, and supervision as may be required to construct the Project as described in these Proposal and Contract Documents.

2.1.2 Related Work

- A. Section 3.0 Settlement Monuments
- B. Section 4.0 Vertical Wick Drains
- C. Section 5.0 Temporary Containment Berms
- D. Section 6.0 Evaporated Salts
- E. Section 7.0 Collection Ditch and Evaporation Ponds
- F. Section 8.0 Geosynthetic Clay Liner (GCL)
- G. Section 9.0 Protection Layer
- H. Section 10.0 Erosion Protection

2.1.3 References

American Society of Testing and Materials (ASTM) most current version:

- A. ASTM D422 - Method for Particle Size Analysis
- B. ASTM D1556 - Test Method for Density of Soil In-Place by the Sand Cone Method
- C. ASTM D698 - Test Methods for Moisture-Density Relationships of Soils and Aggregate Mixtures Using 5.5-lb hammer and 12-in. Drop
- D. ASTM D2487 - Standard Test Method for Classification of Soils for Engineering Purposes
- E. ASTM D2922 - Test Methods for Density of Soils and Soil Aggregate in Place by Nuclear Methods (Shallow Depths)
- F. ASTM D4318 - Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
- G. ASTM C136 - Rock gradations

2.1.4 Submittals

Contractor shall be responsible for submitting the following to the Owner's Representative:

- A. earthwork operations plan and schedule
- B. written plan of operation for the protection of the geosynthetic clay liner (GCL)
- C. sediment control plan

2.1.5 Tolerances

- A. Excavation limits are defined by the lines and elevations shown on the Drawings.
- B. All excavation operations shall be conducted in accordance with Idaho and Federal government laws and regulations
- C. Contractor shall maintain uniform gradients between adjacent spot elevations shown on the Drawings so that GCL can be deployed on a straight uniform grade without sags or humps.
- D. The tolerances for construction on all lines and grades, unless otherwise approved by the Engineer, shall be plus or minus 0.2 feet.
- E. When unfavorable conditions are discovered, they shall be corrected by excavation to lines, grades, depths, and dimensions prescribed by the Engineer.

2.1.6 Quality Assurance

- A. All Work shall be constructed, monitored, and tested in accordance with the requirements set forth by the Engineer.
- B. The Contractor shall be aware of all testing activities and they shall account for these activities



- in the construction schedule.
- C. All soil testing (both field and laboratory testing) will be the responsibility of the CQA Engineer. The Contractor shall be responsible for cooperating with the CQA Engineer during all testing activities. The Contractor shall provide equipment and labor to assist the CQA Engineer in sampling, if requested, and shall also provide access to all areas requiring testing.
 - D. All excavation, backfill, and grading operations shall be carried out under the observation of the CQA Engineer.
 - E. Any Work found unsatisfactory, or any Work disturbed by subsequent operations before acceptance is granted, shall be corrected by the Contractor as directed by the CQA Engineer.

2.1.7 Classification of Excavated Materials

Soils excavated shall be classified as follows:

- A. Common Excavation: This classification includes all material other than rock excavation.
- B. Rock Excavation: This classification includes all solid rock which cannot be removed until loosened by blasting, boring, or wedging. It is further defined as rock of such hardness and texture that it cannot be loosened or broken down by a single shank ripper mounted on a D8 Caterpillar bulldozer (or equivalent) in good operating condition handled by an experienced operator. In areas where it is impractical to classify material by use of the ripper method described, rock excavation is defined as sound material of such hardness that it cannot be excavated with a Caterpillar 225 backhoe (or equivalent) in good operating condition handled by an experienced operator. It also includes boulders and detached pieces of solid rock greater than three-quarters (3/4) of a cubic yard in volume.
- C. Classification: Soil excavated shall be classified as follows:
 - 1. Temporary Cover Material: This material shall consist of clay to cobble sized material existing on top of the impoundment at the beginning of the project
 - 2. Existing Embankment Material: This material shall consist of clay to cobble sized material existing in the current impoundment embankment at the beginning of the project.
 - 3. General Earth: General earth shall consist of the following two materials:
 - a. TP-1: Fine grained soil excavated from the upper layer of the Borrow Area / Diversion Channel excavation. This soil meets the requirements for the Cover System subgrade, Protection Layer, and Embankment Reconstruction. Only material classified as CL, ML, SC, or SM or any combination thereof, under the Unified Soil Classification System (ASTM D2487) will be used. Material will be free of roots, vegetation, or other deleterious materials.
 - b. TP-3: Fine grained soil excavated from the lower layer of the Borrow Area / Diversion Channel excavation. This soil meets the requirements for the Cover System subgrade and Embankment Reconstruction. Only material classified as CL, ML, SC, or SM or any combination thereof, under the Unified Soil Classification System (ASTM D2487) will be used. Material will be free of roots, vegetation, or other deleterious materials.
 - 4. Evaporated Salts: This material consists of potential evaporated salts remaining after completion of fluid evaporation on the top surface of the impoundment. Material sizes may range from clay to cobble sized particles.
- D. Selection and placement of classified soils into separate stockpiles shall be the responsibility of the Contractor. The Contractor shall familiarize himself with the materials classified above. The Engineer reserves the right to approve all material selection.

2.2 Products

2.2.1 Materials

- A. Materials used in conjunction with this Work shall be furnished by the Contractor, derived from the designated borrow area / excavations or off-site sources, and considered incidental to the Work items.
- B. Contractor shall use materials obtained from mandatory excavations / designated borrow areas which meet the applicable specifications. Such materials may be placed in the designated final



- locations direct from the excavation.
- C. Contractor shall schedule excavation, placement, and compaction operations so as to avoid rehandling or stockpiling of excavated material.
 - D. Fill materials will be on-site soils or off-site rock approved by the Engineer. The materials shall be free of organics of other deleterious materials, and shall be excavated, as required, as follows:
 1. Temporary Cover - on-site soils currently existing on the top surface of the impoundment (Temporary Cover), within the existing embankment (Existing Embankment), or in the Borrow Area / Diversion Channel excavation (General Earth). Materials currently on the impoundment surface shall be regraded to construct the temporary fluid containment berms. Materials from the existing embankment shall be utilized to increase temporary berm heights and as pre-loading on the top surface of the impoundment to speed drainage and consolidation of the wastes. After fluid evaporation is complete these materials shall be regraded and compacted, and prepared as the subgrade for the GCL. Materials from the Borrow Area / Diversion Channel excavation may be utilized to complete the 1% overall grade for the top surface of the impoundment.
 2. General Earth - on-site soil materials used to construct general grading fills, a subgrade surface for placement of the GCL in those areas where Temporary Cover materials are excessively rough or large, the Protection Layer directly above the GCL, and/or Embankment Reconstruction. General Earth fill materials can be any on-site material approved by the Engineer.
 3. Rock - materials used as the Surface Layer on the reconstructed embankment out slopes (2" layer of $D_{50} = 1"$ rock) and as erosion protection for the Diversion Channel (6" layer of $D_{50} = 3"$ rock). Rock materials shall consist of sound, hard, durable, inert, uncoated particles of rock or gravel, free from organic matter and other deleterious material, satisfying the requirements of Table 2.1 for erosion protection rock, or as approved by the Engineer.

Specification Table 2.1 Rock Material Specification		
	Material Type	
	Impoundment Embankment Surface Layer	Diversion Channel Erosion Protection
D_{50}	1 inch	3 inches
Minimum Layer Thickness	2 inches	6 inches

2.3 Execution

2.3.1 Clearing and Grubbing

Contractor is responsible for clearing and grubbing as follows:

- A. Clearing shall extend over all new Work areas to be excavated as delineated on the Drawings. Clearing shall extend a maximum of 15 feet and a minimum of 10 feet outside the construction limits or as directed by the Owner's Representative. Areas for clearing shall be released to Contractor by Owner's Representative.
- B. No clearing shall be performed until written permission is given by the Owner's Representative and until the Contractor has provided construction staking for the proposed Work.
- C. Clearing and grubbing shall consist of cutting brush and trees to ground level, and removing such material along with stumps, vegetation, roots one inch (1") in diameter or larger, wood, rubbish, and any other unsuitable fill materials. Vegetation, rubbish, and other unsuitable materials



removed during clearing and grubbing shall be removed from the cleared area and disposed of in an area designated, and in a manner approved by, the Owner's Representative.

- D. In no case shall unsuitable deleterious materials, as determined by the Engineer, be incorporated in the fill materials.

2.3.2 Excavation

Contractor is responsible for excavation as follows:

- A. Excavation shall be performed to the lines and grades shown on the Drawings or as directed by the Engineer. No excavation shall begin until the Contractor has provided construction staking for the proposed Work. All materials excavated shall be used as fill materials as determined by the classification of the material. During excavation, grades shall be maintained to provide drainage of any surface waters that may offset the Work.
- B. Contractor shall minimize the disturbance to surrounding areas during excavation. Where selective excavations are required to obtain materials for GCL subgrade fill, embankment fill, and/or Protection Layer, the material removed from the excavations shall be taken directly to the fill areas or, if required, stockpiled by material types. The stockpiles shall be located at Owner's Representative approved locations.
- C. Excavations shall be graded and properly maintained to provide adequate drainage at all times. Work shall be suspended by Contractor when, in the opinion of the Owner's Representative, the site is overly wet, muddy, or otherwise unsuitable for proper maintenance, until directed otherwise by Owner's Representative.
- D. Where the required lines, levels, and grades are not otherwise defined (such as where Settlement Monuments are to be installed), excavate as necessary for items which are to be placed in the excavations, and as necessary to provide working space to install and inspect those items.
- E. All necessary precautions shall be taken to preserve the materials below and beyond the lines of excavation in the soundest possible condition. Where required to complete the Work, all excess excavation or over-excavation, shall be refilled with approved materials, placed and compacted to the satisfaction of the Owner's Representative.
- F. Safe temporary construction slopes shall be the responsibility of the Contractor. Contractor shall inspect all temporary and permanent open cut excavations on a regular basis for signs of instability. Should signs of instability be noted, Contractor shall undertake remedial measures immediately and shall notify Owner's Representative immediately. It shall be the Contractor's responsibility to remove all loose material from the excavation slopes and to maintain the slopes in a safe and stable condition at all times during the progress of the Work. Permanent cut slopes shall be left in smooth, safe, and stable condition at the end of the workday.
- G. Before excavating rock, submit the proposed method of excavation to the Owner's Representative for review. Ensure the method conforms to all applicable laws and regulations and to proven safe practices for the type of rock, proximity to structures and other installations, and other conditions; prevents opening of seams or otherwise disturbing or breaking the rock beyond the required lines, levels and grades; and keeps the danger and danger areas to the minimum practical. Mandatory use of approved blasting mats to restrain movement of material. Provide all flagman, signs, sirens, and other means necessary for safe use of explosives. Give all notices required by applicable regulations and safety requirements in addition to notices required by the Engineer. Before each blast, clear all personnel, vehicles, etc., from the blast area to safe limits and then ensure no personnel, vehicles, etc., enter the area until after completion of the blast. Scale the sides of rock cuts as soon as possible, preferably as the sides become exposed.

2.3.3 Surface Water Control

Contractor is responsible for surface water control as follows:

- A. Temporary and permanent surface water control features such as berms, basins, and channels will be constructed to the lines, grades, and slopes as approved by the Engineer and maintained during this Work.
- B. Contractor shall construct barriers, berms, dikes, or other measures as required to prevent significant erosion and sediment transport of excavation and fill areas from storm water runoff.



- C. The Contractor shall provide all equipment and facilities, and perform all Work to make and keep the Work areas dry of both surface and sub-surface water and to remove all sediments from all water before it leaves the Site; construct the temporary sediment control systems; improve the systems immediately if improvements are subsequently found to be necessary or prudent.
- D. The Contractor shall prevent injury and damage due to dewatering, disposal of water, and sediment control.
- E. The Contractor shall remove the temporary facilities when they are no longer necessary and restore the areas disturbed by dewatering and temporary sediment control.
- F. The Contractor shall be liable for injury and damage resulting from dewatering and for failure to satisfactorily dewater and control sediment.
- G. The Contractor shall be responsible for the construction of barriers, berms, dikes, or other measures required to control surface water runoff for the orderly progression of Work.

2.3.4 GCL Subgrade Preparation

Contractor is responsible for GCL subgrade preparation as follows:

- A. The GCL shall be placed on suitable subgrade which has been prepared by the Contractor. The subgrade shall be placed or excavated to the lines and grades shown on the Drawings, compacted to a minimum of 90 percent of maximum dry density as determined by the Standard Proctor test (ASTM D698) if General Earth fill is used, and with a minimum of four passes with a smooth-drummed vibratory compactor weighing no less than 10 tons if Temporary Cover or Existing Embankment materials are used.
- B. The subgrade for placement of the GCL shall contain no snow, ice, or frozen, saturated or other deleterious materials as determined by the CQA Engineer.
- C. The Contractor shall protect prepared subgrades from disturbance due to weather, surface water, construction equipment, or other factors. Subgrade surfaces, including previously approved subgrade, which become softened or otherwise unsuitable, shall be repaired to the CQA Engineer's satisfaction. Subgrades found to exhibit swelling, heaving or other similar conditions shall be replaced or reworked by the Contractor to remove such defects.
- D. Sharp rocks or other deleterious debris, vegetation, roots, or sticks in the upper 4 inches of the final grade surface upon which the GCL is to be installed will be removed, with the final surface proof-rolled with a smooth drum drive vibratory compactor until it is smooth (no ridges, ruts, surface irregularities, etc.). Any remaining deleterious material including wheel ruts, that could potentially puncture the GCL, as determined by the GCL Installation Contractor or the CQA Engineer, shall be removed and repaired by the earthworks contractor. Subgrade surfaces to be lined with GCL shall be smooth and free of any as well as free of any voids, large cracks or standing water.
- E. The final grade shall be accepted in writing by the GCL Installation Contractor and approved by the Engineer prior to GCL installation.
- F. It shall be the GCL Installation Contractor's responsibility to indicate to the CQA Engineer any change in the subgrade condition that could cause it to be out of compliance with any of the requirements of this Section or the Specifications.

2.3.5 Fill and Compaction

Contractor is responsible for the following:

- A. Achieving the lines and grades as shown in the Drawings with fill materials.
- B. No GCL or fill materials shall be placed until the foundation and subgrade preparations have been completed as specified herein (Section 2.3.4). The procedures for fill placement shall be discussed with and approved by the Engineer prior to start of fill placement.
- C. No brush, roots, sod, or other deleterious or unsuitable materials shall be incorporated in the fills. The suitability of all materials intended for use in the fill shall be subject to approval by the CQA Engineer. Fill placement shall be temporarily stopped by the Contractor due to unsuitable weather conditions, or if materials and installation do not meet the Specifications. Fill shall not be placed upon frozen material unless approved by the CQA Engineer.
- D. If the surface of the prepared foundation or the rolled surface of any layer is excessively wet for



- fill materials to be placed thereon, it shall be allowed to dry to reduce moisture content to an acceptable level as determined by the CQA Engineer. It shall then be compacted before the next layer of fill material is placed. Determination of such wet conditions shall be by the CQA Engineer.
- E. The distribution of material shall be such that the fill is free from voids, lenses, pockets, streaks, or layers of material differing substantially in texture or gradation from the surrounding material. Where gradations of two materials are not compatible, in the opinion of the CQA Engineer, the Contractor shall remove and replace the incompatible materials.
 - F. Unless otherwise approved by the CQA Engineer, the fill surface shall be at or near the same elevation at all times during construction; maximum permissible difference between differing adjacent fills shall be one foot (1'). At all times during construction, the surface of the fill shall be graded to prevent ponding of water and maintained for storm water drainage.
 - G. Except as otherwise specified or approved by the CQA Engineer, fill shall be dumped and spread in such a manner so that no excessive gaps are left between successively dumped loads of materials. The fill shall be leveled prior to compaction by means of a dozer or grader, or other suitable approved equipment, to obtain a surface free from depressions.
 - H. Except in areas approved by the CQA Engineer where space is limited or otherwise specified, fill placement shall occur by routing the hauling and spreading units approximately parallel to the axis of the fill. As far as practical, hauling units shall be so routed that they do not follow in the same paths, but split their tracks evenly across the surface of the fill to enhance compaction.
 - I. Water required for moisture conditioning shall be applied on the fill or in the borrow areas, with water trucks containing spray bars for even distribution of water. Fill materials shall be maintained at a moisture content near optimum to permit proper compaction to the specified density with the equipment being used. The moisture content of the fill materials, prior to and during compaction, shall be uniform throughout each layer of the material.
 - J. After each layer of fill material has been placed, spread, and moisture-conditioned, the layer shall be compacted by passing compaction equipment over the entire surface of the layer a sufficient number of times to obtain the required density, as specified herein. Compacted lifts shall not exceed twelve inches (12").
 - K. Compaction shall be accomplished with equipment and methods approved by the CQA Engineer. If such equipment or methods are found unsatisfactory for the intended use, the CQA Engineer shall require the Contractor to replace the unsatisfactory equipment with other types or to adjust methods until proper compaction is achieved.
 - L. Where General Earth fill material contains large rocks or rock fragments, place and work the materials so that all solid pieces are well distributed and all interspaces are completely filled. Eliminate such solid pieces, over six inches (6") in their greatest dimension, from fill placed within twelve inches (12") of the surfaces of fill.
 - M. Fill materials placed for the Embankment Reconstruction shall be compacted to a minimum of 90 percent of the maximum dry density as determined by the Standard Proctor (ASTM D698) compaction test. Fill materials placed for the Protection Layer shall be compacted to a maximum of 85 percent of the maximum dry density as determined by the Standard Proctor (ASTM D698) compaction test.
 - N. General Earth fill materials with more than 30 percent rock particles in excess of three quarter inch (3/4") nominal size, which in the opinion of the CQA Engineer are not practical to be tested for moisture density control with ASTM D698 procedures, shall be placed and compacted according to a method specification. Method specifications shall be dependent upon the particular fill material's characteristics, the Contractor's equipment, and the field conditions, but at a minimum, will consist of fill placement in maximum one foot (1') loose lifts and uniformly compacted with a minimum of four passes. The Contractor shall be permitted to use alternative equipment, provided that the Contractor can demonstrate to the CQA Engineer that such alternative equipment shall compact the materials to a density not less than that which would be produced by the equipment specified. The method specifications may be changed at any time, at the discretion of the Engineer, based upon changes in material characteristics, field conditions, and/or equipment.
 - O. Sharp or other deleterious objects in the outer four inches (4") of the final grade surface on the



embankment faces upon which the GCL will be installed, will be removed, with the final surface proof-rolled, with a minimum ten (10) ton, smooth drum drive, vibratory compactor, until it is smooth (no ridges, ruts, surface irregularities, etc.). Any remaining deleterious material including wheel ruts, that could potentially puncture the GCL, as determined by the GCL Installation Contractor or the CQA Engineer, shall be removed and repaired by the earthworks Contractor. The final grade surface shall be accepted in writing by the GCL Installation Contractor and approved by the CQA Engineer prior to GCL installation.

- P. The Contractor shall trim the outer face of the embankment using a dozer, or other suitable equipment, to the lines and grades shown on the Drawings. The final grade shall be approved by the CQA Engineer and Owner's Representative.

2.3.6 Field Quality Assurance

- A. The CQA Engineer will perform soil moisture, dry unit weight, and lift thickness tests in the field in accordance with requirements set forth by the Engineer.
- B. If the CQA Engineer tests indicate Work does not meet the requirements of the Specifications, the CQA Engineer will establish the extent of the nonconforming area. The nonconforming area shall be reworked by the Contractor at Contractor's expense until acceptable test results are obtained.
- C. The Contractor shall be aware of all field CQA testing activities, as these may affect the schedule, and shall comply with the requirements of Section 2.1.6 of this Specification.

2.3.7 Protection of Work

- A. The Contractor shall use all necessary means to protect all materials and all partially completed and completed Work of these Specifications.
- B. In the event of damage, the CQA Engineer will identify areas requiring repair, and the Contractor shall make all repairs and replacements necessary to the approval of the Owner's Representative and at no additional cost to the Owner.
- C. At the end of each day, the Contractor shall verify that the entire work area was left in a state that promotes surface drainage off and away from the area and from finished Work. If threatening weather conditions are forecast, compacted surfaces shall be seal-rolled or covered with plastic sheeting to protect finished Work.

2.3.8 Survey Control

- A. Contractor's Surveyor shall perform pre-construction and post-construction surveys of the final regraded temporary cover surface immediately prior to GCL deployment, exposed existing impoundment liner and berm, reconstructed embankments, top of Protection and Surface Layers, and Diversion Channel areas prior to placement of fill materials and to determine quantities for payment purposes.
- B. Contractor's Surveyor shall provide Record Drawings of the locations and elevations of the impoundment facility including the GCL liner tie-in trench, final Diversion Channel configuration, Settlement Monument elevations, and top of both the Protection Layer and Surface Layer (erosion protection). Contractor's Surveyor shall submit these Drawings to the Owner's Representative.



3.0 Settlement Monuments

3.1 General

3.1.1 Description

- A. This Section describes the requirements for fabrication and installation of six (6) settlement monuments that will be placed on top of the impoundment prior to initiation of vertical wick drain installation.
- B. The Work includes furnishing all labor, tools, equipment, and supervision as may be required to construct the Work as described in the Proposal and Contract Documents.

3.1.2 Related Work

- A. Section 2.0 General Excavation, Backfilling, and Compaction
- B. Section 4.0 Vertical Wick Drains
- C. Section 5.0 Temporary Containment Berms
- D. Section 8.0 Geosynthetic Clay Liner (GCL)
- E. Section 9.0 Protection Layer

3.1.3 Tolerances

The Contractor is responsible for maintaining tolerances as follows:

- A. Contractor's Surveyor shall collect survey elevation data from each of the monuments on a regular (weekly) basis, or as required by the Engineer or Owner's Representative. Survey time intervals may increase or decrease depending on the amount of drainage and consolidation occurring.
- B. Contractor shall immediately notify Owner's Representative if, and when monuments are contacted, bumped, touched, or otherwise disturbed by any and all equipment, vehicles, or other objects such as, but not limited to, rocks or debris.
- C. Contractor's Surveyor shall re-survey any and all disturbed monuments within 24 hours of any such contact.
- D. Contractor's Surveyor shall re-survey all monuments after re-installation in the Protection Layer.

3.2 Products

3.2.1 Materials

- A. Each Settlement Monument shall consist of a minimum one inch (1") diameter, six foot (6') tall metal "stand pipe" welded to a metal base plate.
- B. Base plates shall be a minimum one-quarter inch (1/4") thick, and one foot (1') by one foot (1').
- C. All portions of the standpipe and base plate shall be painted flourescent orange.
- D. Standpipe tops shall be flagged at all times after installation.
- E. Each monument will be "tagged" with an individual identification number, such as SM #1, SM#2, etc.

3.3 Execution

3.3.1 Placement

- A. Monument base plates will be buried at a depth of approximately one (1') to two (2') feet below the current temporary cover surface (for stability and protection). Stand pipes will extend approximately four (4') to five (5') feet above the ground surface after installation.
- B. Monuments will be removed prior to installation of the GCL.
- C. Monuments will be re-installed approximately six (6") to eight (8") inches into the Protection Layer after construction of the Protection Layer is completed.



3.3.2 Protection of Work

- A. Contractor shall use all means necessary to protect the monuments and to not contact, bump, touch, or otherwise disturbed any monument with any and all equipment, vehicles, or other objects such as, but not limited to, rocks or debris.
- B. Contractor shall immediately notify Owner's Representative if, and when monuments are contacted, bumped, touched, or otherwise disturbed by any and all equipment, vehicles, or other objects such as, but not limited to rocks or debris.
- C. In the event of any contact, the Owner's Representative will identify any monuments requiring repair, and the Contractor shall make all repairs and replacements necessary to the approval of the Owner's Representative and at no additional cost to the Owner.

3.3.3 Survey Control

The Contractor is responsible for survey control as follows:

- A. Contractor's Surveyor shall collect survey elevation data from each of the monuments on a regular (weekly) basis, or as required by the Engineer or Owner's Representative. Survey time intervals may increase or decrease depending on the amount of drainage and consolidation occurring.
- B. Contractor's Surveyor shall re-survey any and all disturbed monuments within 24 hours of any such contact.
- C. Contractor's Surveyor shall re-survey all monuments after re-installation in the Protection Layer.
- D. Contractor's Surveyor shall provide a Record Drawing to the Owner of the final location and top elevation of all monuments.



4.0 Vertical Wick Drains

4.1 General

4.1.1 Description

- A. This Section describes the requirements for installation of vertical wick drains at locations as directed by the Engineer.
- B. The Work includes furnishing all labor, tools, equipment, and supervision as may be required to construct the Work as described in the Proposal and Contract Documents.

4.1.2 Related Work

- A. Section 4.0 Temporary Containment Berms
- B. Section 6.0 Evaporated Salts
- C. Section 8.0 Geosynthetic Clay Liner (GCL)

4.1.3 Submittals

The Contractor shall provide to the following information relating to the vertical wick drains manufacturer with its Proposal.

- A. Information from manufacturer including company name, address, telephone number, the names of the company president and manufacturing quality control manager, and narrative of the company history.
- B. Description of manufacturer's manufacturing capabilities:
 - 1. Information on plant size, equipment, personnel, number of shifts per day, and capacity per shift.
 - 2. A list of standard material properties and test methods employed to arrive at the values for each. As a minimum, the list shall include properties given in Section 4.2.1.
- C. Contractor shall provide the following information after contract award, but within ten (10) days prior to materials arrival on-site and prior to commencement of the Work:
 - 1. Size, type, weight, maximum pushing force, and configuration of the installation rig
 - 2. Dimension and length of mandrel
 - 3. Details of drain anchorage
 - 4. Detailed description of proposed installation procedures
 - 5. Proposed methods for overcoming obstructions
 - 6. Proposed methods for splicing drains
 - 7. A copy of the manufacturer's QC test results of properties outlined in Part 4.2.1 of this Section. The Owner's Representative reserves the right to refuse use of any wick drain material without proper QC documentation.
 - 8. A detailed list of performance criteria for the wick drain material being produced for this Project.
- D. Contractor shall submit a one (1) meter sample of the drain materials to the Engineer / Owner's Representative prior to installation and shall allow three (3) weeks for evaluation of the material. The sample shall be stamped or labeled by the manufacturer as being representative of the drain material having the specified trade name. Approval of the material by the Engineer / Owner's Representative shall be required prior to delivery of the drain material.

4.1.4 Quality Assurance

- A. All Work shall be installed and monitored in compliance with requirements in the Construction Quality Assurance Plan (Section 1.6). Contractor and manufacturer shall participate and comply with all items in these Specifications and requirements of the CQA Plan.
- B. Contractor shall demonstrate that his equipment, methods, and materials produce a satisfactory installation in accordance with these Specifications. For this purpose, Contractor shall install several trial drains at locations within the Work area as designated



by the Engineer / Owner's Representative. Trial drains conforming to these Specifications will be paid for at the same unit price as the production drains.

- C. Contractor shall ensure that wick drain manufacturer has an internal product quality control program that meets Contract requirements.
- D. Contractor shall be aware of all activities outlined in the CQA Plan, and Contractor shall account for these activities in the construction schedule.
- E. Wick drain material that does not meet the requirements of this Specification will be rejected. Contractor will be required to replace the rejected material with new material that complies to the Specification, at no additional cost to Owner.

4.1.5 Delivery, Handling, and Storage

A. Packing and Shipping

- 1. Drain material shall be stamped or labeled by the manufacturer as being representative of the drain material having the specified trade name. Approval of the material by the QA Engineer / Owner's Representative shall be required prior to delivery of the drain material.
- 2. Contractor shall protect drain material from sunlight, mud, dirt, dust, debris, puncture, cutting, or other damage.
- 3. Contractor shall ensure that drain material is properly loaded and secured to prevent damage during transit.
- 4. Contractor shall ensure personnel responsible for loading, transport, and unloading are familiar with handling and transport constraints imposed by manufacturer.

B. Acceptance at Site:

- 1. Owner's Representative shall perform inventory and surface inspection for defects and damage of all drain material upon delivery.
- 2. Contractor shall inspect any drain material that may be damaged.
- 3. Contractor shall repair damage from handling and transport of drain material at no cost to Owner. If irreparable, in the opinion of the Owner's Representative, damaged materials shall be replaced at not cost to Owner.

C. Storage and Protection

- 1. Owner's Representative shall designate on-site storage area for drain material from time of delivery until installation.
- 2. Storage of drain materials is the responsibility of Contractor from the time materials are off-loaded until installation of materials is accepted. Contractor is responsible for preparing storage location and for protection of the materials from the elements (i.e., sunlight, dust, dirt, etc.)
- 3. Contractor shall preserve integrity and readability of drain material labels, and store such that Owner's Representative and CQA Engineer have access to the information to verify acceptance.

4.2 Products

4.2.1 Materials

- A. The prefabricated wick drain material shall consist of a continuous plastic (polypropylene) drainage core wrapped in a non-woven geotextile fabric of continuous filaments of 100% polypropylene similar to or equivalent of products known as Nilex Mebra-Drain or Ameridrain.
- B. The geotextile wrap shall be tight around the core and shall be seamed in a manner that will not all introduction of any new materials nor present an obstruction that will impede flow in the channels of the core.



4.3 Execution

4.3.1 Installation

- A. Drains shall be installed in the locations shown on the Drawings, or as directed by the Owner's Representative or Engineer.
- B. Drains that deviate from the plan location by more than six inches (6"), or that are damaged, or improperly installed will be rejected. Rejected drains will be abandoned in place.
- C. Replacement drains shall be offset approximately twenty inches (20") from the location of the rejected drain
- D. Drains shall be installed vertically, within a tolerance of not more than 1:50 (H:V). Installation equipment shall be carefully checked for plumbness, and the Contractor shall provide the Owner's Representative with a suitable means of verifying the plumbness of the mandrel and of determining depth of drain at any time.
- E. Splices or connections in the drain material shall be completed in a professional manner that ensures continuity of the drain without diminishing the flow characteristics of the wick material.
- F. Splices shall be a minimum of six inches (6") in length. The drain shall be cut such that at least a six inch (6") length protrudes above the top of the ground surface at each drain location.
- G. If preaugering, or other methods, are required to clear obstructions and facilitate the installation of drains, then the depth of preaugering, or other method used, shall be subject to the approval of the Owner's Representative.
- H. Where obstructions are encountered within the compressible strata, which cannot be penetrated by augering, or other methods, the Contractor shall abandon the hole. At the direction of the Owner's Representative, Contractor shall then install a new drain within twenty inches (20") of the obstructed drain. A maximum of two attempts shall be made, as directed by the Owner's Representative, for each obstructed drain.
- I. Drains shall be installed to the depth of 13', or as specified by the Engineer.
- J. Drains shall be installed in such a manner as to not disturb settlement monuments already in place. The repair an/or replacement of monuments damaged as a result of the Contractor's activities shall be the responsibility of the Contractor.



5.0 Temporary Containment Berms

5.1 General

5.1.1 Description

- A. This Section describes the requirements for construction of the temporary containment berms which will contain fluids leaving the wastes via the vertical wick drains.
- B. The Work includes furnishing all labor, tools, equipment, and supervision as may be required to construct the Work as described in the Proposal and Contract Documents.

5.1.2 Related Work

- A. Section 2.0 General Excavation, Backfilling, and Compaction
- B. Section 3.0 Settlement Monuments
- C. Section 4.0 Vertical Wick Drains

5.1.3 Tolerances

Contractor is responsible for maintaining tolerances as follows:

- A. Temporary containment berms locations are shown on the Drawings.
- B. Maintain uniform berm heights as necessary to limit potential flow between berms.

5.2 Products

5.2.1 Materials

All temporary containment berms shall be constructed of temporary cover materials existing on the top surface of the impoundment. Additional materials from the existing embankment excavation or the Borrow Area / Diversion Channel Excavation may be used as necessary to contain fluids.

5.3 Execution

5.3.1 Construction

Contractor is responsible for construction of temporary fluid containment berms as follows:

- A. One perimeter berm will be constructed around the entire top surface of the impoundment at approximately twenty feet (20') in from the break between the top surface and the embankment outslope.
- B. Additional berms will be constructed on approximate thirty foot (30') centers from north to south and east to west as shown in the Drawings.
- C. Grade existing temporary cover material into perimeter and interior berms approximately one foot (1') in height and with spacing of approximately thirty feet (30'), or as directed by the Engineer or Owner's Representative.
- D. Perimeter berm will be constructed prior to initiation wick drain installation.
- E. Interior berms will be constructed immediately after installation of the Vertical Wick Drains, following the installation process to capture potential fluids exiting from the drains.
- F. Grading operations will be scheduled so as to not interfere with wick drain installation or operation of the installation equipment.

5.3.2 Protection of Work

- A. Contractor shall maintain the berms as needed for liquid retention, to prevent erosion of the embankment outslopes, and contain all liquids and solids on the top surface of the impoundment.
- B. In the event of any breach or damage to the berms, the Contractor shall immediately notify the Owner's Representative. The Contractor shall make all repairs and replacements necessary to the approval of the Owner's Representative and at no additional cost to the Owner.



6.0 Evaporated Salt Materials

6.1 General

6.1.1 Description

- A. This Section describes the requirements for removal and disposal of evaporated salts (if any) remaining after evaporation of liquids temporarily retained on top of the impoundment.
- B. The Work includes furnishing all labor, tools, equipment, and supervision as may be required to construct the Work as described in the Proposal and Contract Documents.

6.1.2 Related Work

- A. Section 2.0 General Excavation, Backfilling, and Compaction
- B. Section 8.0 Geosynthetic Clay Liner

6.1.3 Quality Assurance

All Work shall be constructed, monitored, and tested compliance with requirements in the Construction Quality Assurance Plan (Section 1.6).

6.2 Products

6.2.1 Materials

This material will consist of evaporated salts (if any) remaining after completion of fluid evaporation on the top surface of the impoundment.

6.3 Execution

6.3.1 Removal and Disposal

- A. Contractor shall excavate, combine, dispose of evaporated salts as directed by the Owner's Representative or Engineer.
- B. All evaporated salts (if any) shall be removed and disposed of prior to GCL deployment.



7.0 Collection Ditch and Evaporation Ponds

7.1 General

7.1.1 Description

- A. This Section describes the requirements for removal and disposal of Collection Ditch and Evaporation Pond materials currently located along the southwest embankment of the impoundment.
- B. The Work includes furnishing all labor, tools, equipment, and supervision as may be required to construct the Work as described in the Proposal and Contract Documents.

7.1.2 Related Work

- A. Section 2.0 General Excavation, Backfilling, and Compaction
- B. Section 8.0 Geosynthetic Clay Liner

7.1.3 Quality Assurance

All Work shall be constructed, monitored, and tested compliance with requirements in the Construction Quality Assurance Plan (Section 1.6).

7.2 Products

7.2.1 Materials

This material consists of all existing installed geosynthetic liner materials located along the southwest embankment of the impoundment, visible evaporated salts, and other materials associated with the Collection Ditch and Evaporation Ponds. Soils material sizes may range from clay to cobble sized particles.

7.3 Execution

7.3.1 Excavation and Disposal

- A. Contractor shall excavate, combine, compact, and bury all Collection Ditch and Evaporation Pond materials within the impoundment as directed by the Owner's Representative or Engineer.
- B. All Collection Ditch and Evaporation Pond materials shall be removed and disposed of prior to GCL deployment.



8.0 Geosynthetic Clay Liner (GCL)

8.1 General

8.1.1 Description

- A. This Section describes the requirements for manufacture, supply, and installation of the Geosynthetic Clay Liner (GCL) as shown in the Drawings; and construction quality assurance monitoring. All procedures, operations, and methods shall be in strict compliance with the Specifications, the Quality Assurance Plan, and the Drawings.
- B. The Work includes furnishing all labor, tools, equipment, and supervision as may be required to construct the Work as described in the Proposal and Contract Documents.

8.1.2 Related Work

- A. Section 2.0 General Excavation, Backfilling, and Compaction
- B. Section 6.0 Evaporated Salts
- C. Section 7.0 Collection Ditch and Evaporation Ponds
- D. Section 9.0 Protection Layer

8.1.3 Submittals

- A. The Contractor shall provide the following information relating to the GCL manufacturer.
 - 1. Information from manufacturer including company name, address, telephone number, the names of the company president and manufacturing quality control manager, and narrative of the company history.
 - 2. Description of manufacturer's manufacturing capabilities:
 - a. Information on plant size, equipment, personnel, number of shifts per day, and capacity per shift.
 - b. A list of standard material properties and test methods employed to arrive at the values for each. As a minimum, the list shall include properties given in Section 8.2.1.
 - 3. The Quality Control Manual followed during the manufacturing process including those for the clay and polymer materials, and a description of the quality control laboratory facilities, including the name and telephone number of the quality control manager. Upon review of the Quality Control Manual, the Owner's Representative and CQA Engineer may request additional testing during the manufacturing process at no additional cost to Owner. The Quality Control Manual shall become part of the Contract Documents following Owner's Representative and CQA Engineer's review and acceptance.
- B. Contractor shall provide the following information after contract award, but within ten (10) days prior to material arrival on-site and prior to commencement of the Work:
 - 1. The GCL manufacturer shall provide written certification that the GCL to be used meets the requirements of the Apex Project and that needle punched non-woven geotextiles have been continuously inspected for the presence of needles and geotextile was found to be needle free.
 - 2. A copy of the manufacturer's GCL QC test results of properties outlined in Section 8.2. The Owner's Representative reserves the right to refuse use of any GCL supplied without the proper QC documentation.
 - 3. A detailed list of performance criteria for the GCL material being produced for this project. Performance criteria refers to "minimum property values".

8.1.4 Quality Assurance

- A. All Work shall be constructed, monitored, and tested compliance with requirements in the Construction Quality Assurance Plan (Section 1.6). Contractor and manufacturer shall participate and comply with all items in these Specifications and requirements of the CQA plan.



- B. Contractor shall ensure that GCL manufacturer has an internal product quality control program that meets Contract requirements.
- C. Contractor shall be aware of all activities outlined in the CQA Plan, and Contractor shall account for these activities in the construction schedule.
- D. Contractor shall assure that the GCL is delivered to the site at least 14 calendar days prior to installation to allow sufficient time for conformance testing, if necessary.
- E. GCL material that does not meet the requirements of this Specification will be rejected. Contractor will be required to replace the rejected material with new material that complies to the Specification, at no additional cost to Owner.
- F. In order to prevent weather damaged GCL from being placed, the following procedures shall be followed:
 - 1. Contractor shall perform its Work and utilize sufficient ballast as necessary to prevent wind uplift of the GCL panels.
 - 2. If weather damage should occur, Owner's Representative and CQA Engineer shall determine if the GCL shall be repaired or replaced. Weather damage to the GCL will include hydrated bentonite, loss of bentonite, tears, dirty fabric, as determined by the Owner's Representative and CQA Engineer.
 - 3. Repair or replacement of the weather damaged GCL shall be completed by Contractor at no additional cost to Owner.
 - 4. As determined by Owner's Representative and CQA Engineer, the GCL panel may be rejected at no cost to Owner.

8.1.5 Delivery, Handling, and Storage

- A. Packing and Shipping
 - 1. GCL shall be supplied in rolls wrapped in relatively impermeable and opaque protective covers, with straps for unloading.
 - 2. GCL rolls shall be marked or tagged with the following information:
 - a. Manufacturer's name
 - b. Product information
 - c. Roll number
 - d. Batch or lot number
 - e. Roll directions
 - 3. Contractor shall ensure that GCL rolls are properly loaded and secured to prevent damage during transit.
 - 4. Contractor shall protect GCL from excessive heat, cold, puncture, cutting, moisture, or other damaging or deleterious conditions.
 - 5. Contractor shall ensure personnel responsible for loading, transport, and unloading are familiar with handling and transport constraints imposed by manufacturer.
- B. Acceptance at Site:
 - 1. Owner's Representative shall perform inventory and surface inspection for defects and damage of all drain GCL rolls upon delivery.
 - 2. Contractor shall unroll and inspect any GCL roll that may be damaged below the surface.
 - 3. Contractor shall repair damage from handling and transport of GCL at no cost to Owner. If irreparable, in the opinion of the Owner's Representative, damaged materials shall be replaced at no cost to Owner.
- C. Storage and Protection
 - 1. Owner's Representative shall designate on-site storage area for drain material from time of delivery until installation.
 - 2. Storage of GCL is the responsibility of Contractor from the time materials are off-loaded until installation of materials is accepted. Contractor is responsible for preparing storage location and for protection of the materials from the elements (i.e., sunlight, dust, dirt, etc.)
 - 3. After Contractor has removed material from the storage area, protect GCL from puncture, dirt, groundwater, fluids, moisture, mud, mechanical abrasion, excessive heat,



- ultraviolet light exposure, and other sources of potential damage.
4. GCL rolls shall be stored in relatively opaque and water tight wrappings.
 5. Contractor shall preserve integrity and readability of GCL roll labels, and store such that Owner's Representative and CQA Engineer have access to the information to verify acceptance.

8.2 Products

8.2.1 Materials

- A. The GCL shall consist of a layer of natural sodium bentonite clay encapsulated between two geotextiles and shall comply with all criteria listed in this Section.
- B. Reinforced GCL must be used on embankment out slopes as designated by the Engineer. Unreinforced GCL may be used on slopes not exceeding 10:1 (H:V).
- C. Acceptable unreinforced GCL products are Claymax 200R, or an Engineer approved equivalent. Acceptable reinforced GCL products are Bentomat DN, or an Engineer approved equivalent.
- D. Delineation of areas requiring reinforced GCL will be agreed upon by the GCL Installation Contractor and the Owner's Representative / CQA Engineer prior to installation.
- E. GCL properties shall meet or exceed the minimum values shown in Table 8.1 below:

Specification Table 8.1 Minimum Values for GCL		
Property	Test Method	Value
Values for GCL Material		
Bentonite Swell Index	ASTM D5890	24 ml/2 g min
Bentonite Fluid Loss	ASTM D5891	18 ml max.
Bentonite Mass/Area	ASTM D5993	0.75 lb/ft ²
Values for Reinforced GCL Material		
GCL Grab Strength	ASTM D4632	150 lbs MARV
GCL Peel Strength	ASTM D4632	15 lbs min.
GCL Permeability	ASTM D5887	5 x 10 ⁻⁹ cm/sec max.
Geotextile Mass/Unit Area	ASTM D5261	3.0 oz/yd ²
GCL Hydrated Internal Shear Strength	ASTM D5321	500 lbs/ft ²
Values for Unreinforced GCL Material		
GCL Grab Strength	ASTM D4632	100 lbs MARV
GCL Permeability	ASTM D5887	5 x 10 ⁻⁹ cm/sec max.
Geotextile Mass/Unit Area	ASTM D5261	3.0 oz/yd ²
GCL Hydrated Internal Shear Strength	ASTM D5321	50 lbs/ft ²



8.3 Execution

8.3.1 Installation

A. GCL deployment shall not begin until Contractor's Surveyor has verified that subgrade elevations and grades conform to the Drawings and until the CQA Engineer documents that the Contractor's Work is in conformance with the Proposal Documents.

B. GCL Deployment

Contractor shall handle GCL in a manner to ensure that GCL is not damaged, and shall comply with the following:

1. Installation Contractor and Owner's Representative shall review and agree upon which type of GCL (Reinforced and Unreinforced) shall be placed in which areas prior to installation.
2. GCL shall be delivered to the Work area on the Site in the original packaging. Immediately prior to deployment, packaging shall be carefully removed without damaging the GCL. The GCL shall be oriented (which side faces up) in accordance with the Engineer's recommendation.
3. No equipment or tools shall damage the GCL by handling, trafficking, or other means.
4. No personnel working on the GCL shall smoke, wear damaging shoes, or engage in other activities that could damage the GCL.
5. Dragging the GCL across the subgrade shall be minimized, and if dragging is necessary, a slip sheet shall be used to reduce friction damage.
6. GCL shall not be deployed during precipitation events, in the presence of excessive moisture, (e.g., fog, dew, frost, rain, snow, sleet, hail), in an area of ponded fluids, or in the presence of excessive winds.
7. GCL shall not be deployed over frozen ground, unless approved by Owner's Representative and CQA Engineer.
8. In the presence of wind, all GCL shall be weighted with sandbags or the equivalent. Such sandbags shall be installed during deployment and shall remain until replaced with cover materials.
9. GCL panels shall be deployed in such a manner as to preclude wrinkles and folds.
10. GCL panels shall be deployed parallel to the direction of the slope.
11. GCL shall be cut with a cutter approved by Owner's Representative and CQA Engineer, such as scissors. Unshielded razor knives are not acceptable.
12. During deployment care shall be taken to not entrap in or beneath the GCL, stones, excessive dust, or moisture that could potentially damage the GCL or hamper subsequent seaming or overlap.
13. Following installation of all GCL, and prior to placing covering material, an examination of the entire surface shall be conducted to detect potentially harmful foreign objects. Any such foreign objects found shall be removed or the panel shall be replaced by the Contractor, at no cost to Owner.
14. GCL that is hydrated before placement of overlying cover material shall be replaced.
15. Only deploy GCL that can be covered during that day by a minimum of twelve inches (12") of approved cover soil.

C. Anchorage

1. Contractor shall place in an anchor trench the end of the GCL roll as directed in the Drawings.
2. The front edge of the trench shall be rounded so as to eliminate any sharp corners.

D. Seaming

1. Panels shall be overlapped a minimum of six inches (6").
2. The overlap zone shall be kept free of soil or other debris.
3. A continuous bead of supplemental bentonite shall be applied in the overlap zones at the rate required by the manufacturer (typically one quarter (1/4) pound per lineal foot).
4. Seams at the end of panels shall be constructed such that they are shingled in the



direction of the grade to prevent the potential for runoff flow entering the overlap zone.

E. Defects and Repairs

Contractor shall repair holes or tears in the GCL as follows:

1. Remove all soil or other material that may have penetrated the torn GCL.
2. Repair all flows or damage areas by placing a patch of the same GCL material extending a minimum of twelve inches (12") overlap in all directions. Apply granular bentonite between the GCL layers in the overlap area at rate required by the manufacturer.

8.3.2 Placement of Cover Soils

Contractor shall place all soil materials to be located on top of the GCL in such a manner as to ensure:

- A. The GCL is not damaged.
- B. Minimal slippage of the GCL on the underlying layers occurs.
- C. No excess tensile stresses shall occur in the GCL, such as by earthmoving equipment making sudden stops, starts, or turns. Only low ground pressure (LGP) equipment, approved by the Owner's Representative and Engineer, for the material type and layer thickness, shall be used by the Contractor.
- D. A minimum thickness of one foot (1') of cover shall be maintained between the equipment tires/tracks and the GCL at all times during the covering process.
- E. Soil cover shall be placed in a manner that prevents soil from entering the GCL overlap zones.
- F. Cover soil shall be pushed up slopes and not down to minimize tensile forces on the GCL.



9.0 Protection Layer

9.1 General

9.1.1 Description

- A. This Section describes the requirements for construction of the Protection Layer on top of the GCL, and rebuilding of the exterior impoundment embankments.
- B. The Work includes furnishing all labor, tools, equipment, and supervision as may be required to construct the Work as described in the Proposal and Contract Documents.

9.1.2 Related Work

- A. Section 2.0 General Excavation, Backfilling, and Compaction
- B. Section 3.0 Settlement Monuments
- C. Section 8.0 Geosynthetic Clay Liner
- D. Section 10.0 Erosion Protection

9.1.3 References

American Society for Testing and Materials (ASTM) most current version:

- A. ASTM D422 - Method for Particle Size Analysis
- B. ASTM D1556 - Test Method for Density of Soil In-Place by the Sand Cone Method
- C. ASTM D698 - Test Methods for Moisture-Density Relationships of Soils and Aggregate Mixtures Using 5.5-lb hammer and 12-in. Drop
- D. ASTM D2487 - Standard Test Method for Classification of Soils for Engineering Purposes
- E. ASTM D2922 - Test Methods for Density of Soils and Soil Aggregate in Place by Nuclear Methods (Shallow Depths)
- F. ASTM D4318 - Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

9.1.4 Submittals

Contractor shall submit a plan and schedule for delivery and placement of the Protection Layer soils, including a description of the equipment and procedures to be used and methods for placement. This plan and schedule shall be approved by the Owner's Representative and Engineer prior to the start of Protection Layer placement.

9.1.5 Tolerances

Contractor is responsible for maintaining tolerances as follows:

- A. Placement limits are defined by the lines and elevations shown on the Drawings, and shall be a minimum of one foot (1').
- B. Maintain uniform gradients between adjacent spot elevations, without sags or humps.
- C. Finish grade top of Protection Layer surface to within +0.0 to +0.2 feet of lines and elevations shown on the drawings.

9.1.6 Quality Assurance

- A. Contractor shall place Surface Protection materials in accordance with these Specifications and industry construction practices acceptable to the CQA Engineer.
- B. The Contractor shall be aware of all CQA activities and shall account for these activities in the construction schedule.
- C. All soil testing (both field and laboratory testing) will be the responsibility of the CQA Engineer. The Contractor shall be responsible for cooperating with the CQA Engineer during all testing activities. The Contractor shall provide equipment and labor to assist the CQA Engineer in sampling, if requested, and shall provide access to all areas requiring testing.
- D. Contractor shall be responsible for replacing Protection Layer material not meeting the Specifications as determined by field testing.
- E. Any Work found unsatisfactory or any Work disturbed by subsequent operations before



acceptance is granted shall be corrected by the Contractor as directed by the CQA Engineer.

9.2 Products

9.2.1 Materials

- A. Protection Layer soils shall be prepared by the Contractor and tested by the CQA Engineer.
- B. Protection Layer soils shall be free of roots, woody vegetation, particles greater than two inches (2") in diameter, and other deleterious material.
- C. Protection Layer shall not be compacted to greater than 85% of maximum density as determined by ASTM D698.

9.3 Execution

9.3.1 Placement

- A. Protection Layer placement shall begin only after acceptance of GCL materials.
- B. The Contractor shall construct the Protection Layer in one (1) lift not to be less than one foot (1') in thickness at all times.
- C. A minimum thickness of one foot (1') of Protection Layer soils shall be maintained between the equipment tires/tracks and the GCL at all times during the covering process.
- D. Protection Layer soils shall be placed in a manner that prevents soil from entering the GCL overlap zones.
- E. Protection Layer soils shall be pushed up slopes and not down to minimize tensile forces on the GCL.

9.3.2 Field Quality Assurance

- A. The CQA Engineer will perform soil moisture, dry unit weight, and lift thickness tests in the field on the Protection Layer soil to determine compliance with this Specification. Testing will be carried out in accordance with the requirements set forth by the Engineer.
- B. If the CQA Engineer's test results indicate Work does not meet the requirements of the Specifications, the CQA Engineer will establish the extent of nonconforming area. The nonconforming area shall be reworked or replaced by the Contractor, at their expense, until acceptable test results are obtained.
- C. The Contractor shall be aware of all field quality assurance testing activities, as these may affect their schedule, and they shall comply with the requirements of these Specifications.

9.3.3 Protection of Work

- A. After Protection Layer soils have been placed, the Contractor shall maintain it free of ruts, depressions, and damage resulting from the hauling and handling of any material, equipment, tools, etc.
- B. The Contractor shall use all means necessary to protect all materials and all partially completed and completed Work of these Specifications.
- C. In the event of damage, the CQA Engineer will identify any areas requiring repair, and the Contractor shall make all repairs and replacements necessary to the approval of the Owner's Representative and at no additional cost to the Owner.

9.3.4 Survey Control

- A. Contractor's surveyor shall survey the final location and elevation of the top of the Protection Layer to determine quantities for payment.
- B. Contractor's Surveyor shall provide a Record Drawing to the Owner of the final location and elevation of the top of the Protection Layer.



10.0 Erosion Protection

10.1 General

10.1.1 Description

- A. This Section describes the requirements for placement of erosion protection along the out slopes of the impoundment, and at the edge of the Diversion Channel where it intersects the toe of the impoundment.
- B. The Work includes furnishing all labor, tools, equipment, and supervision as may be required to construct the Work as described in the Proposal and Contract Documents.

10.1.2 Related Work

- A. Section 2.0 General Excavation, Backfilling, and Compaction
- B. Section 9.0 Protection Layer

10.1.3 References

American Society for Testing and Materials (ASTM) most current version:

- A. ASTM C136 - Rock Gradations

10.1.4 Submittals

Contractor shall submit erosion material samples prior to delivery for testing by CQA Engineer in accordance with the Specifications.

10.1.5 Tolerances

Contractor is responsible for maintaining tolerances as follows:

- A. Placement limits are defined by the lines and elevations shown on the Drawings.
- B. Maintain uniform gradients between adjacent spot elevations on the Drawings, without sags or humps.
- C. Place erosion protection material within +0.0 to +0.2 feet of the lines and elevations shown on the drawings.

10.1.6 Quality Assurance

- A. All Work shall be placed, monitored, and tested in accordance with the requirements set forth by the Engineer.
- B. The Contractor shall be aware of all CQA activities and shall account for these activities in the construction schedule.
- C. On-site conformance testing and field quality assurance testing of granular materials will be the responsibility of the CQA Engineer. The CQA Engineer will obtain conformance samples of the erosion protection material upon delivery to the site. The Contractor shall provide equipment and labor to assist the CQA Engineer in sampling, if requested, and shall provide access to all areas requiring testing. The Contractor shall repair any damage to finished Work caused by the CQA Engineer's sampling or testing activities at no cost to Owner.
- D. Quality Control testing (in accordance with Section 10.2) of the erosion protection material at the source shall be the responsibility of the Contractor.
- E. The CQA Engineer shall be responsible for checking the thickness of the erosion protection material layer during placement. However, thickness checking by the CQA Engineer does not relieve the Contractor of their responsibility to lay out and control the Work. The Contractor and CQA Engineer will cooperate with each other to the maximum degree possible.



10.2 Products

10.2.1 Materials

- A. Erosion protection material shall consist of sound, hard, durable, inert, uncoated particles of rock or gravel, free from organic matter and other deleterious material, satisfying the requirements of Table 2.1 for erosion protection rock, or as approved by the Engineer.
- B. Contractor shall submit a Quarry Certificate and gradation curve for material to CQA Engineer for approval prior to delivery of material to the site.

10.3 Execution

10.3.1 Placement

- A. Contractor shall place erosion protection material as shown on the Drawings.
- B. Soils excavated to allow for placement of diversion channel erosion protection will be backfilled and compacted in place after acceptance of erosion protection by the CQA Engineer.

10.3.2 Field Quality Assurance

- A. The CQA Engineer will verify the gradation and the final thickness of erosion protection material to determine compliance with this Specification. Testing will be carried out in accordance with the requirements set forth by the Engineer.
- B. If the CQA Engineer's test results indicate Work does not meet the requirements of the Specifications, the CQA Engineer will establish the extent of nonconforming area. The nonconforming area shall be reworked or replaced by the Contractor, at their expense, until acceptable test results are obtained.
- C. The Contractor shall be aware of all field quality assurance testing activities, as these may affect their schedule, and they shall comply with the requirements of these Specifications.

10.3.3 Protection of Work

- A. After erosion protection material has been placed, the Contractor shall maintain it free of soils, ruts, depressions, and damage resulting from the hauling and handling of any material, equipment, tools, etc.
- B. The Contractor shall use all means necessary to protect all materials and all partially completed and completed Work of these Specifications.
- C. In the event of damage, the CQA Engineer will identify any areas requiring repair, and the Contractor shall make all repairs and replacements necessary to the approval of the Owner's Representative and at no additional cost to the Owner.

10.3.4 Survey Control

Contractor's Surveyor shall provide a Record Drawing to the Owner of the final location and elevation of the top of the erosion protection layer along the impoundment embankment out slopes and the diversion channel.

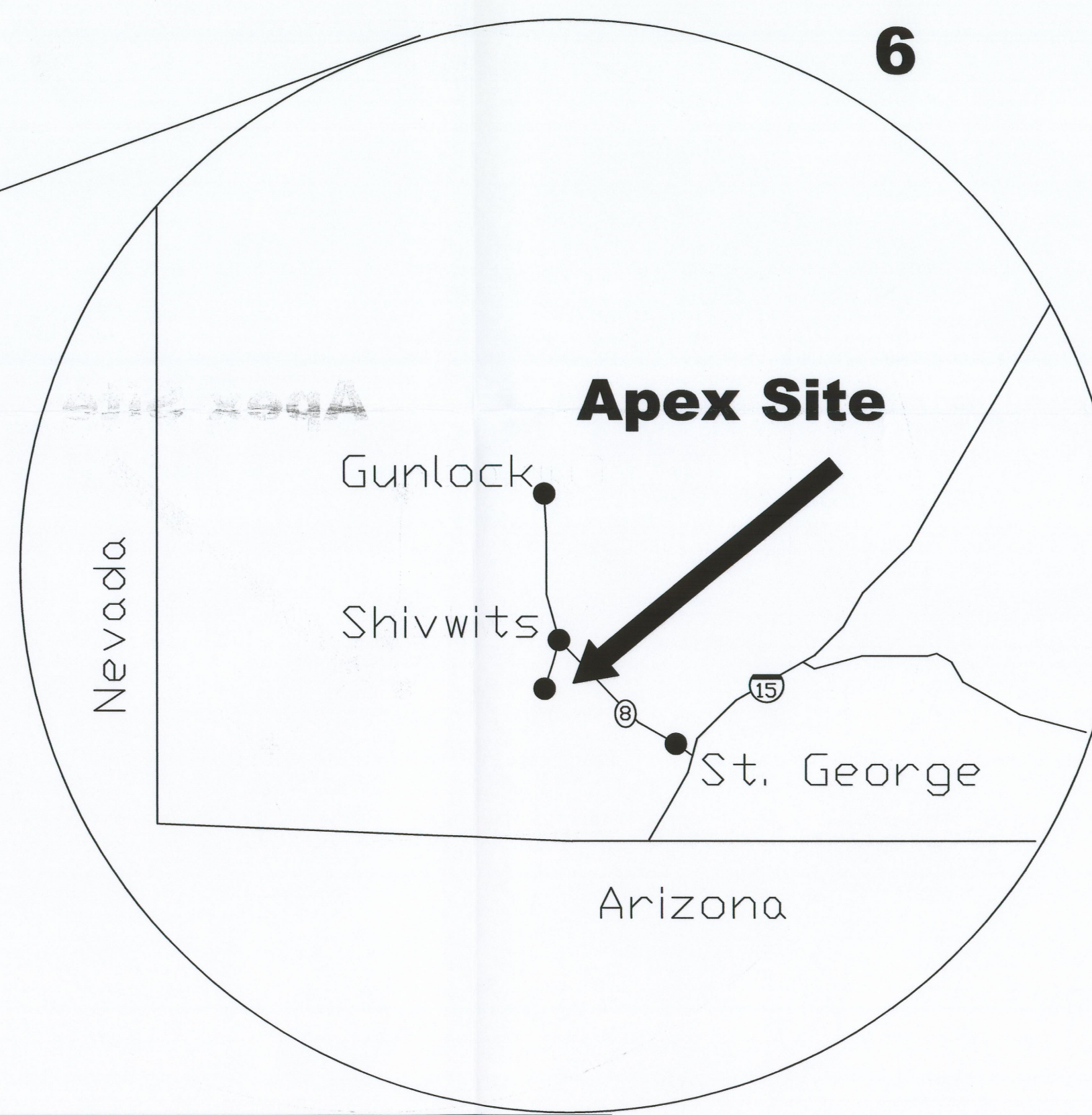
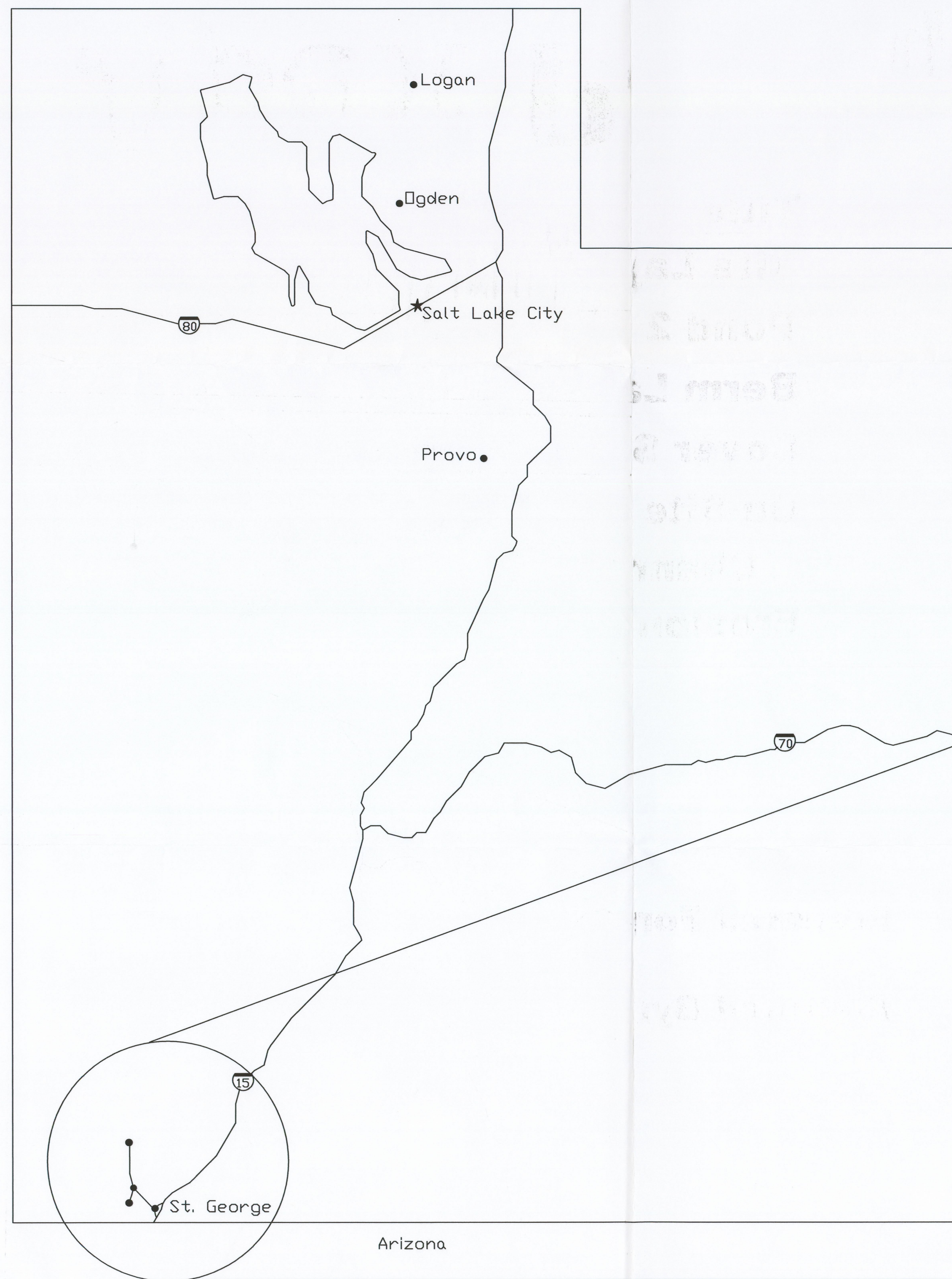


Plans For Construction

Apex Pond 2 - Final Reclamation

Hecla Mining Company

St. George, Utah



Drawing No.

1

2

3

4

5

6

Title

Site Layout

Pond 2 Plan View and Profile

Berm Layout and Embankment Profile

Cover System Details

On-Site Borrow Area and Diversion

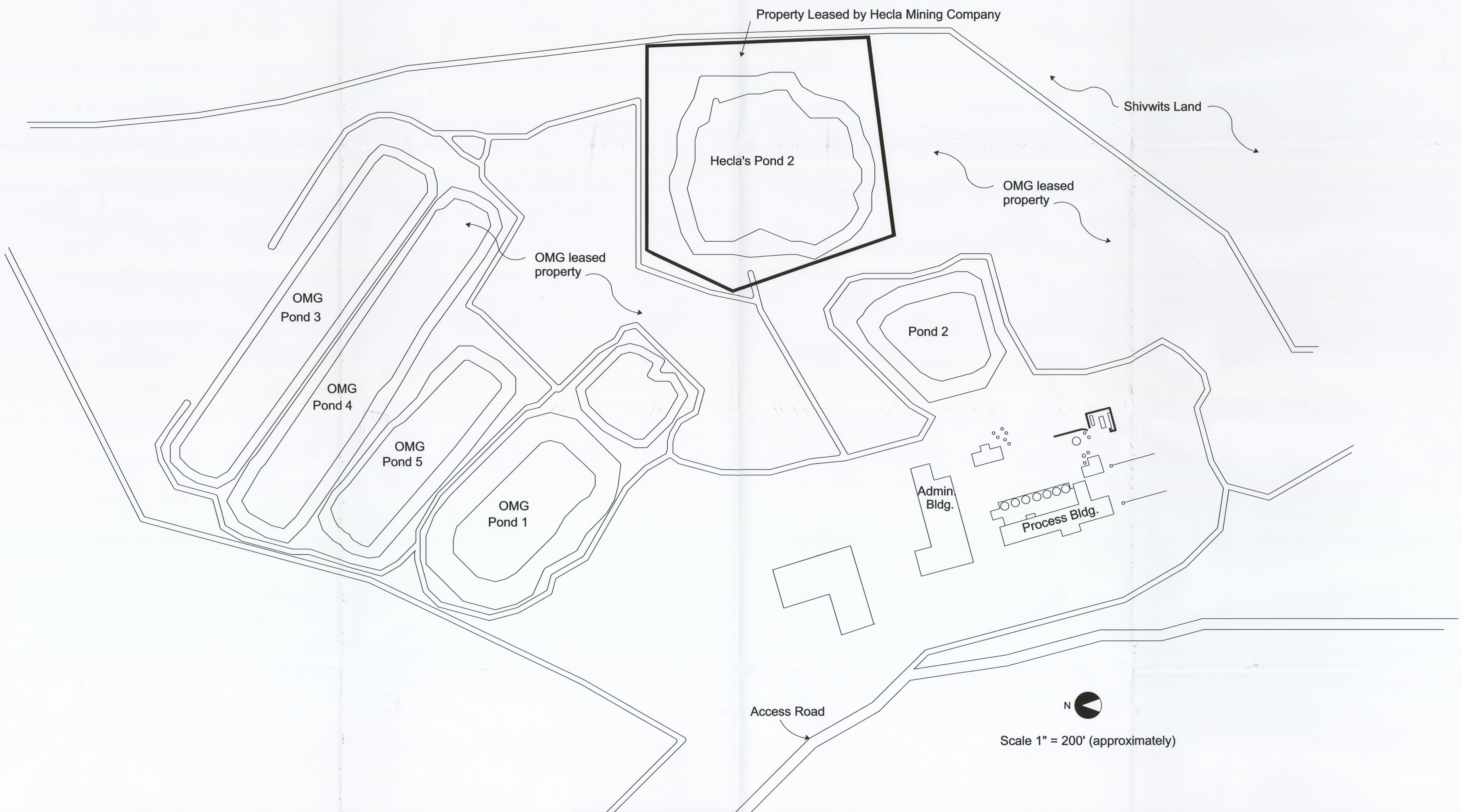
Channel Plan and Profiles

Erosion Protection Detail

Prepared For: Hecla Mining Company

Prepared By: MONSTER ENGINEERING INC.

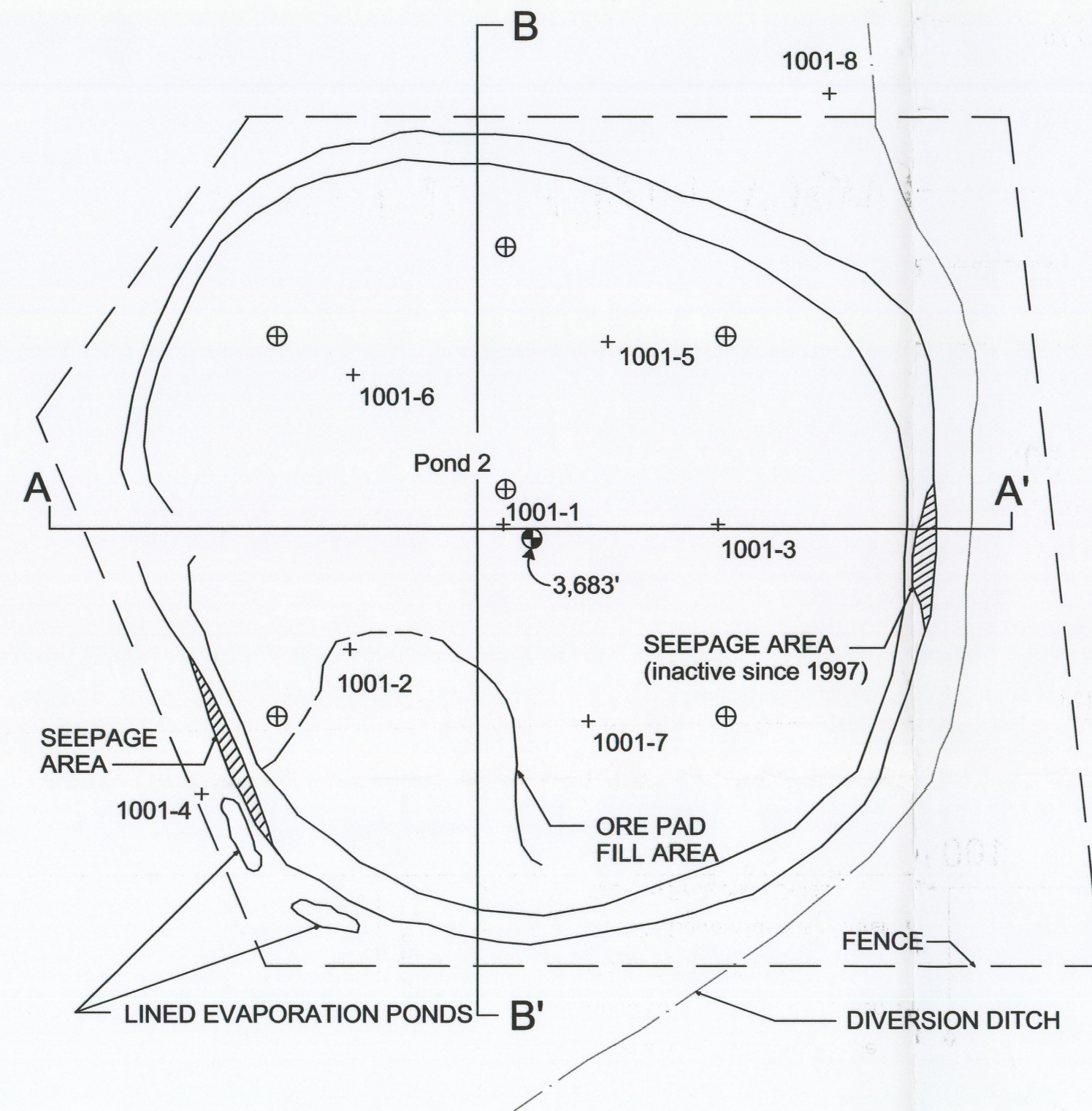
Site Layout



REVISIONS	NO.	BY	CKD.	DATE	REFERENCES	DRWG. #	DRWG. TITLE	DESIGNERS	DES.	BY	DATE	<div>Hecla MINING COMPANY</div>	<div><div>This drawing is the property of HECLA MINING COMPANY.</div><div>This drawing is furnished for the sole use of the recipient and acceptance of same constitutes an agreement that it will not be published, reproduced or given to any other party without our permission unless furnished to recipient under contract provisions and shall remain the property of Hecla Mining Company subject to return on request</div></div>	<div><div>PREPARED BY:</div><div>MONSTER ENGINEERING INC.</div></div>	<div>Apex Site</div>	TITLE: Drawing 1 Site Layout
						1	Site Layout									
						2	Pond 2 Plan View and Profile		DRAWN	OWS.	7/03					
						3	Berm Layout and Embankment Profile		CKD.	D.O.G.	3/04					
						4	Cover System Details		APPR.							
						5	On-Site Borrow Area & Diversion Channel Plan & Profile									
						6	Erosion Protection Detail									

ENR 4/5/99
B-1-1

Pond 2 Plan View



Note: +1001-8 = Bore hole locations and numbers

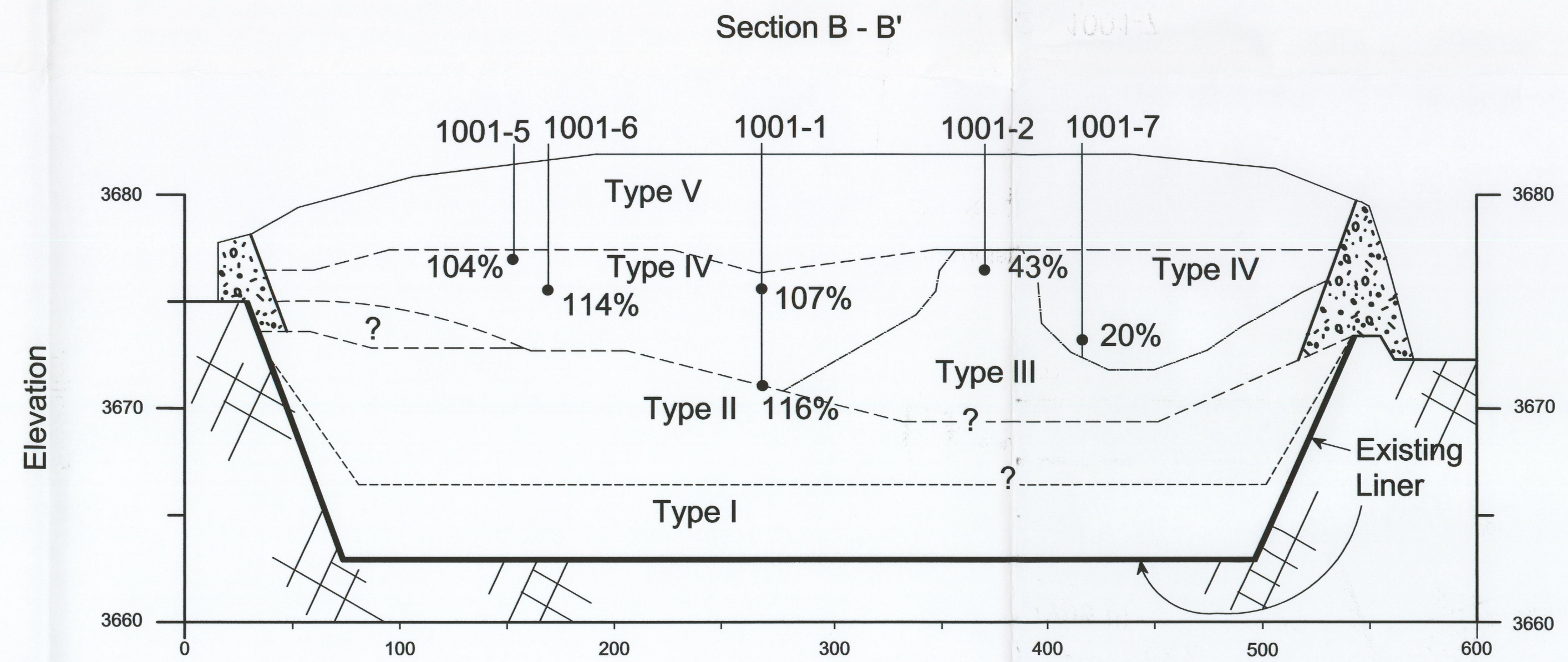
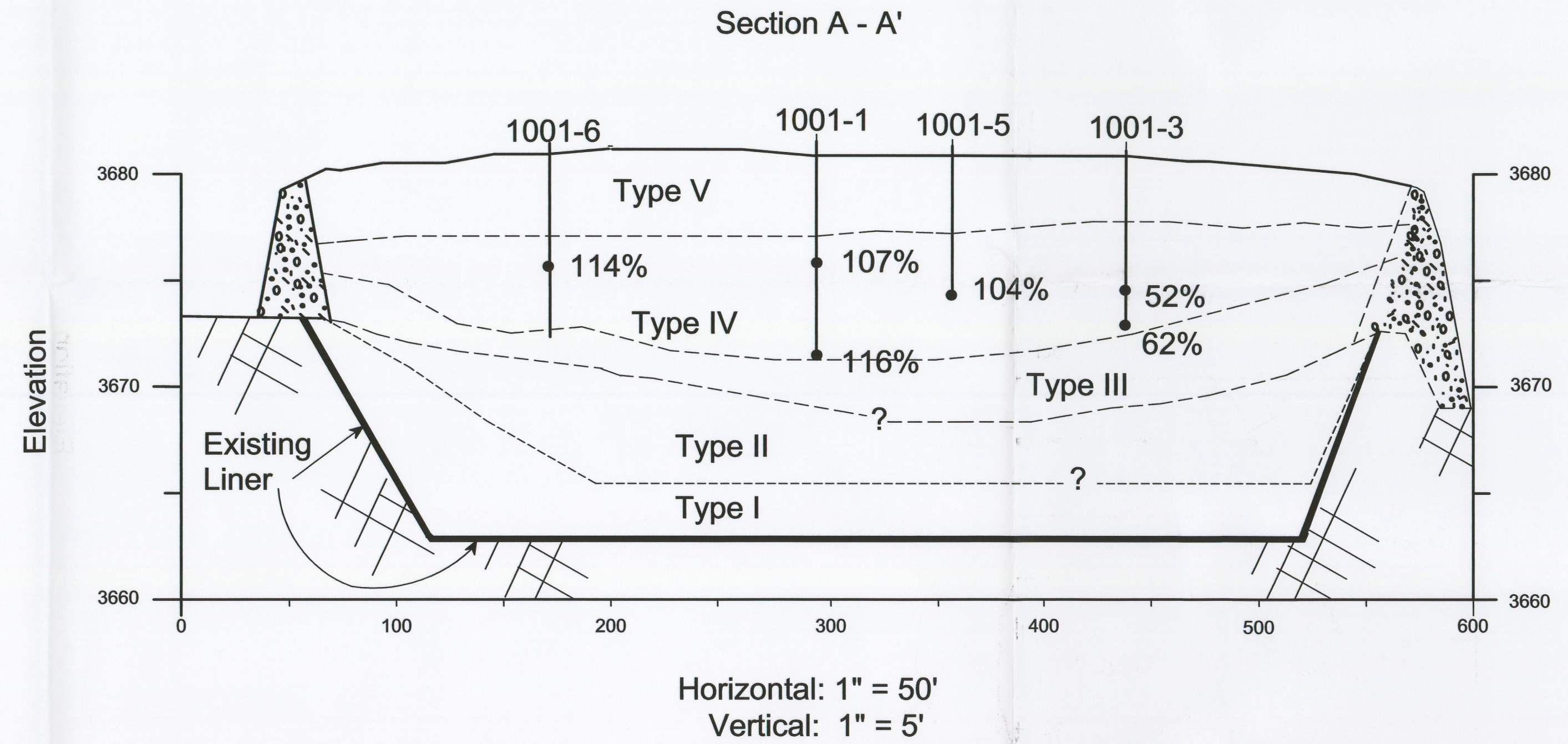
⊕ = Settlement monuments to be installed, locations are approximate

⬤ = Top elevation for reggraded temporary cover material and embankment materials

Scale 1" = 100'



Pond 2 Profile



Material Types:

- I - SGMC Tailings
- II - SGMC 2A, 1B, 1C, 3BN, 3BS, 3A
- III - Hecla Pond 1A/B- Soil Mixture
- IV - Hecla Pond 3A (plus old liner materials, pumped as slurry)
- V - Temporary Cover Material

Horizontal: 1" = 50'
Vertical: 1" = 5'

Notes:

- 114% (sample locations and moisture content)

Pond contents are estimates only

Borehole locations are estimates

REVIEWS	NO.	BY	CKD.	DATE	REFERENCES	DRWG. #	DRWG. TITLE	DESIGNERS		BY	DATE
						1	Site Layout		DES.	D.O.G.	6/03
						2	Pond 2 Plan View and Profile		DRAWN	OWS.	7/03
						3	Berm Layout and Embankment Profile		CKD.	D.O.G.	3/04
						4	Cover System Details		APPR.		
						5	On-Site Borrow Area & Diversion Channel Plan & Profile				
						6	Erosion Protection Detail				

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PREPARED BY:

**MONSTER
ENGINEERING
INC.**

Apex Site

TITLE:

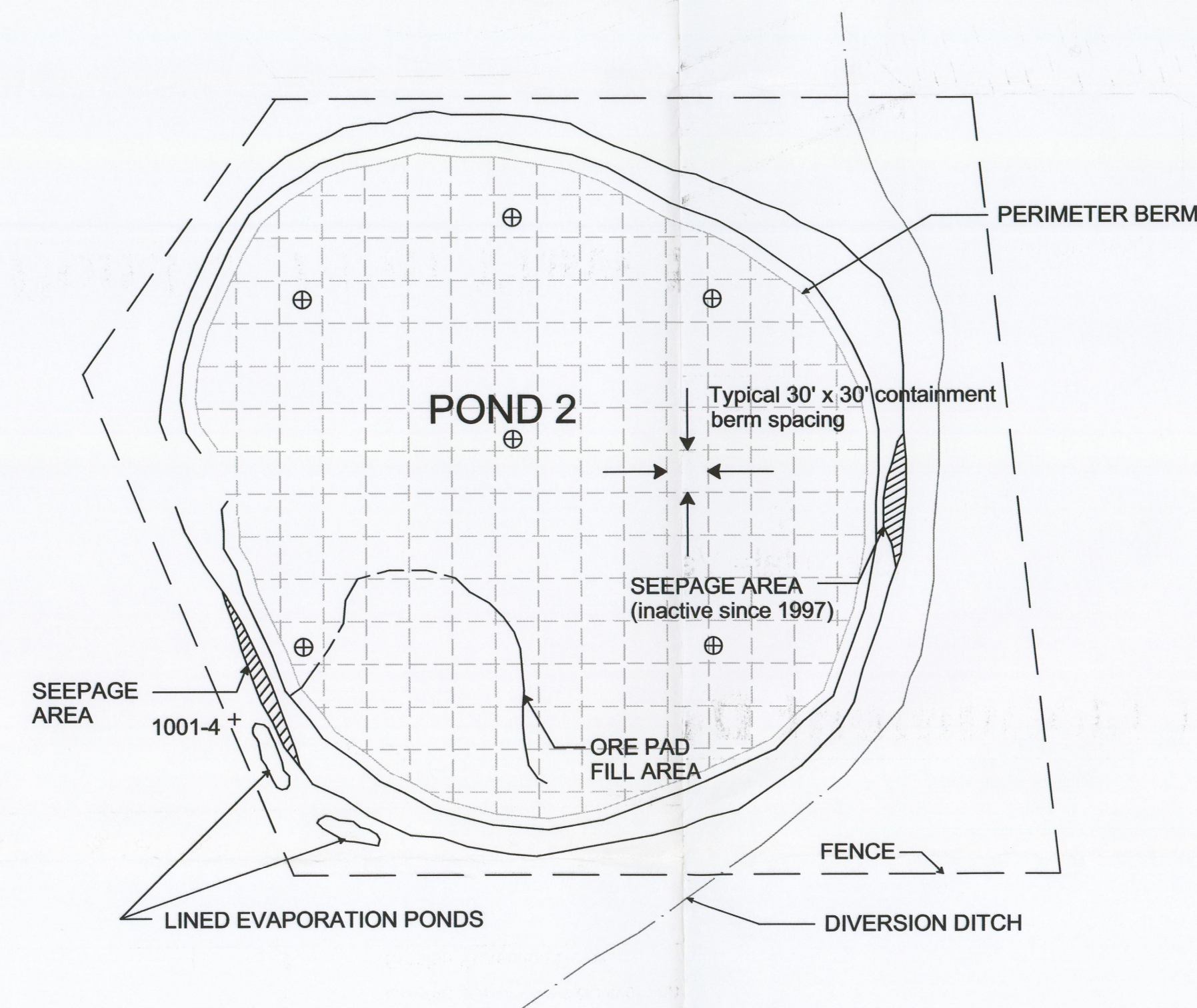
Drawing 2

Pond 2

Plan View and Profile

EPA NO. 4590002
FILE NO. B1-1

Pond 2 Plan View Berm Layout

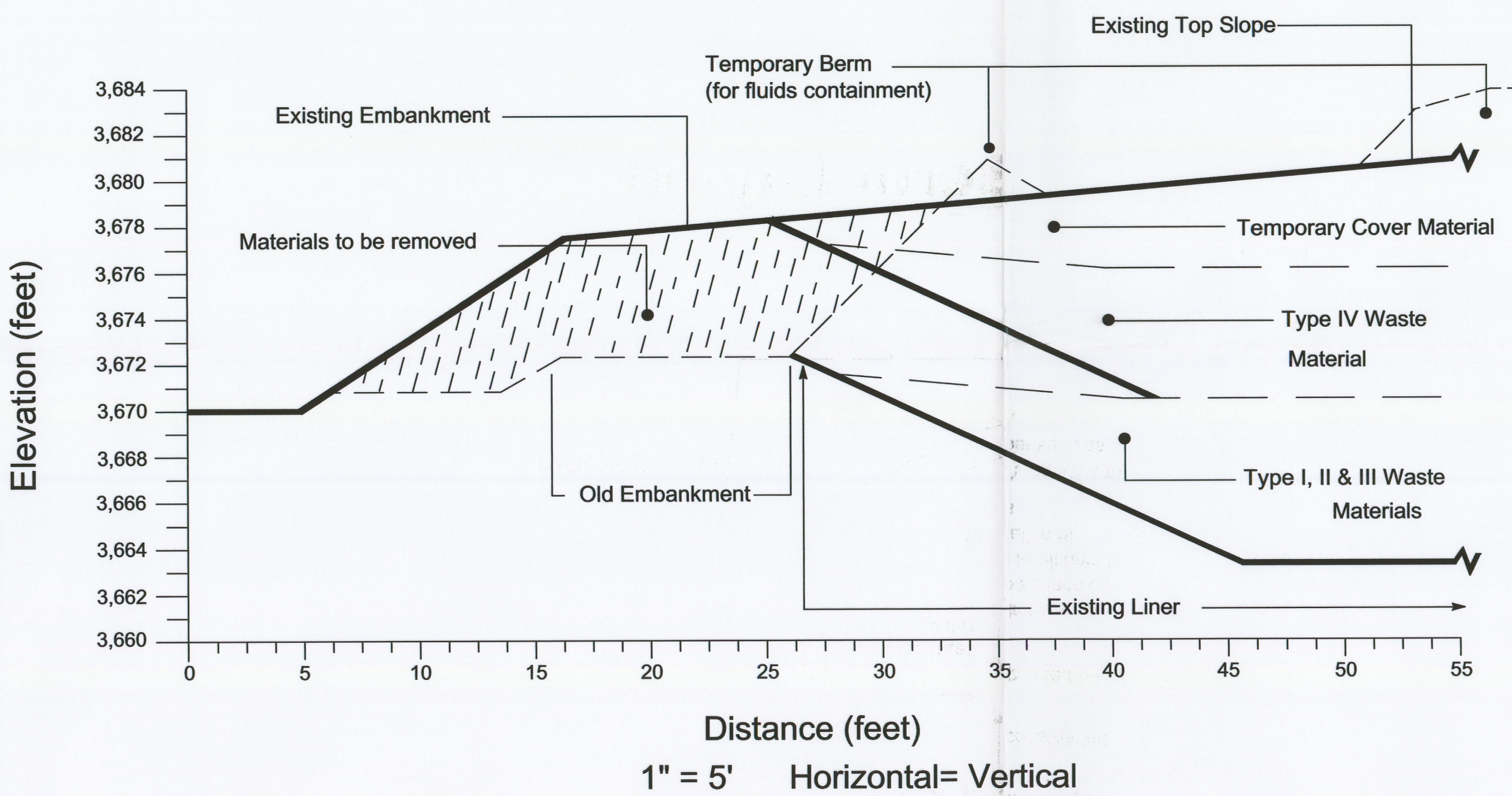


Note: ⊕ = Settlement monuments to be installed, locations are approximate

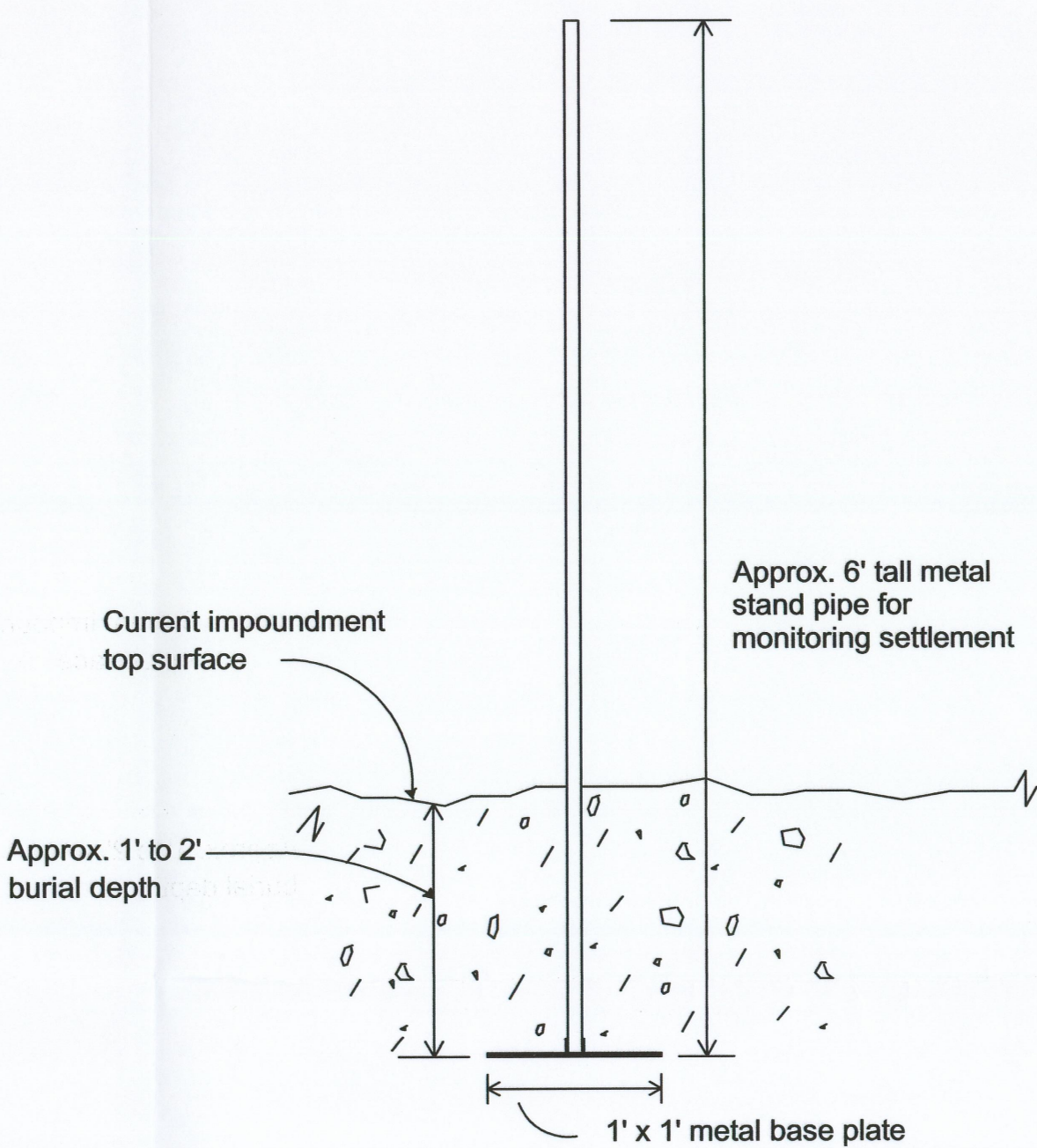
Distance (feet)
1" = 100'



Typical Embankment Profile




Typical Settlement Monument Design and Installation



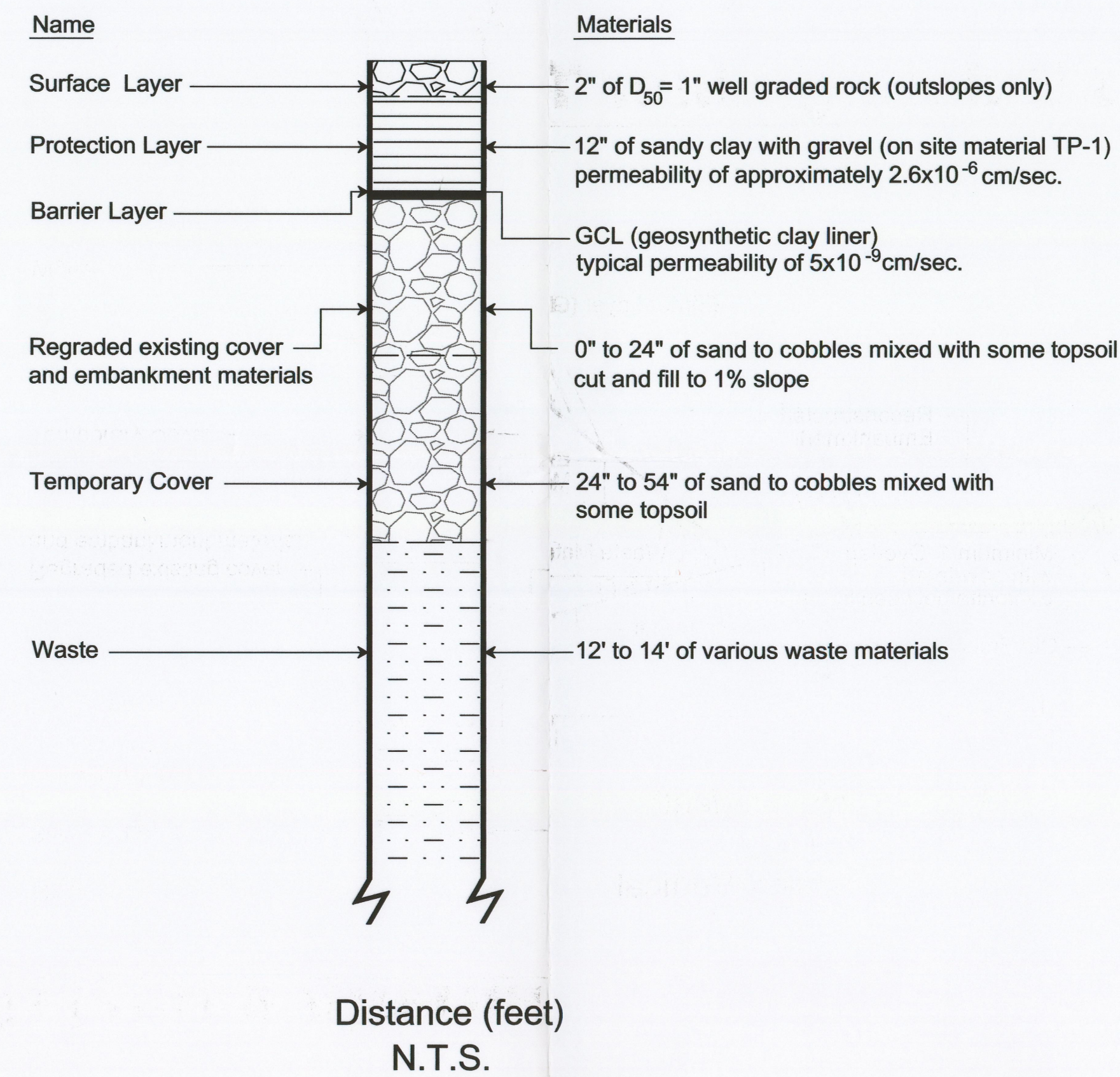
Distance (feet)
1" = 1'

Notes:

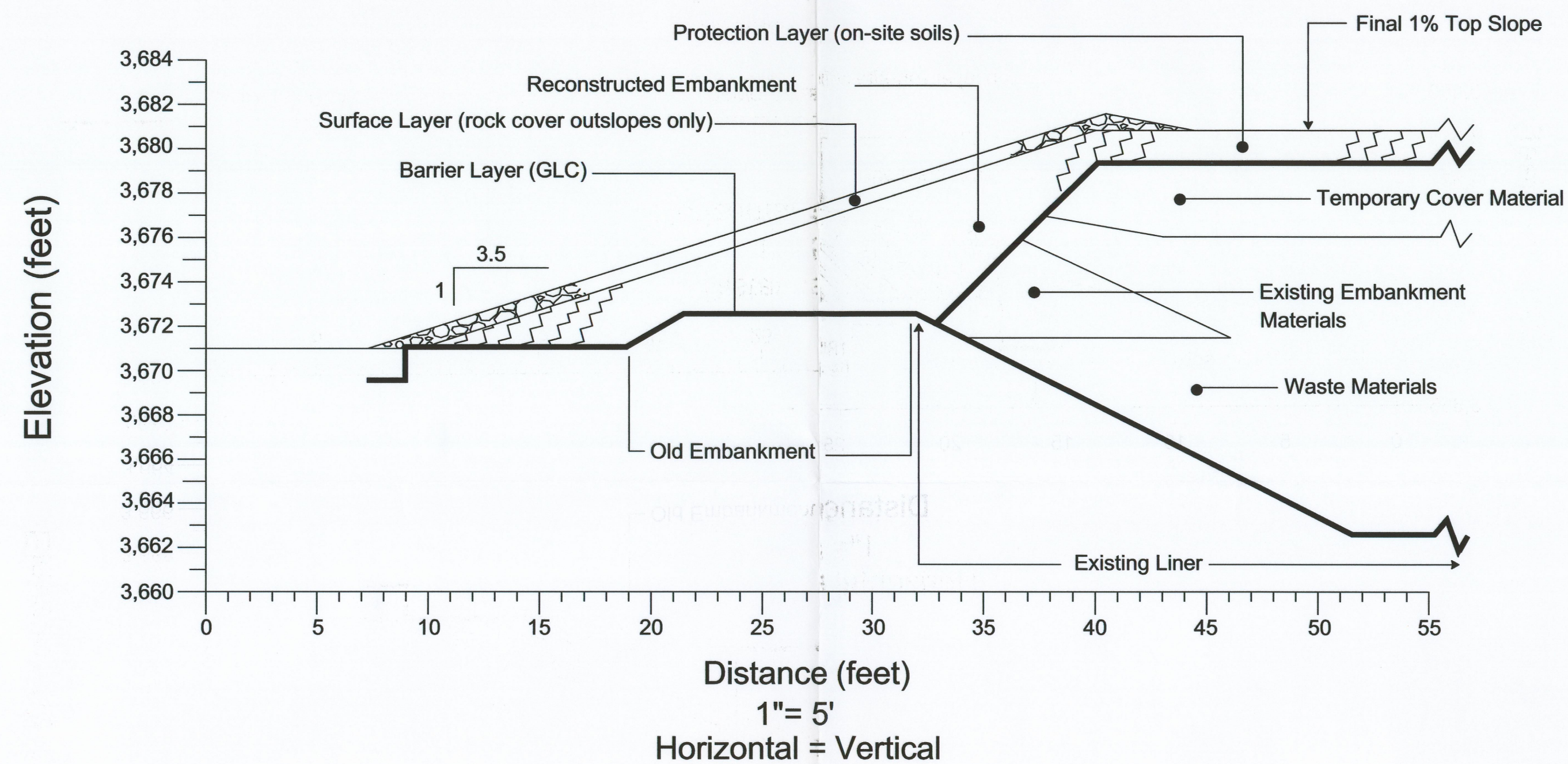
- Stand pipes to be welded/permanently attached to base plates
- Stand pipes to be constructed of 1" diameter steel
- Stand pipes to be painted bright color for better visibility
- Top of stand pipe to be surveyed prior to loading top surface of impoundment with additional fill materials or installation of vertical wick drains
- Stand pipes to be "tagged" with identification number such as SM #1, SM #2, etc.

REVISIONS	NO.	BY	CKD.	DATE	DRWG. #	DRWG. TITLE	DESIGNERS	DES.	BY	DATE	PREPARED BY:  MONSTER ENGINEERING INC.	Apex Site	TITLE: Drawing 3 Berm Layout and Embankment Profile
					1	Site Layout		DRAWN	OWS.	7/03			
					2	Pond 2 Plan View and Profile		CKD.	D.O.G.	3/04			
					3	Berm Layout and Embankment Profile		APPR.					
					4	Cover System Details							
					5	On-Site Borrow Area & Diversion Channel Plan & Profile							
					6	Erosion Protection Detail							

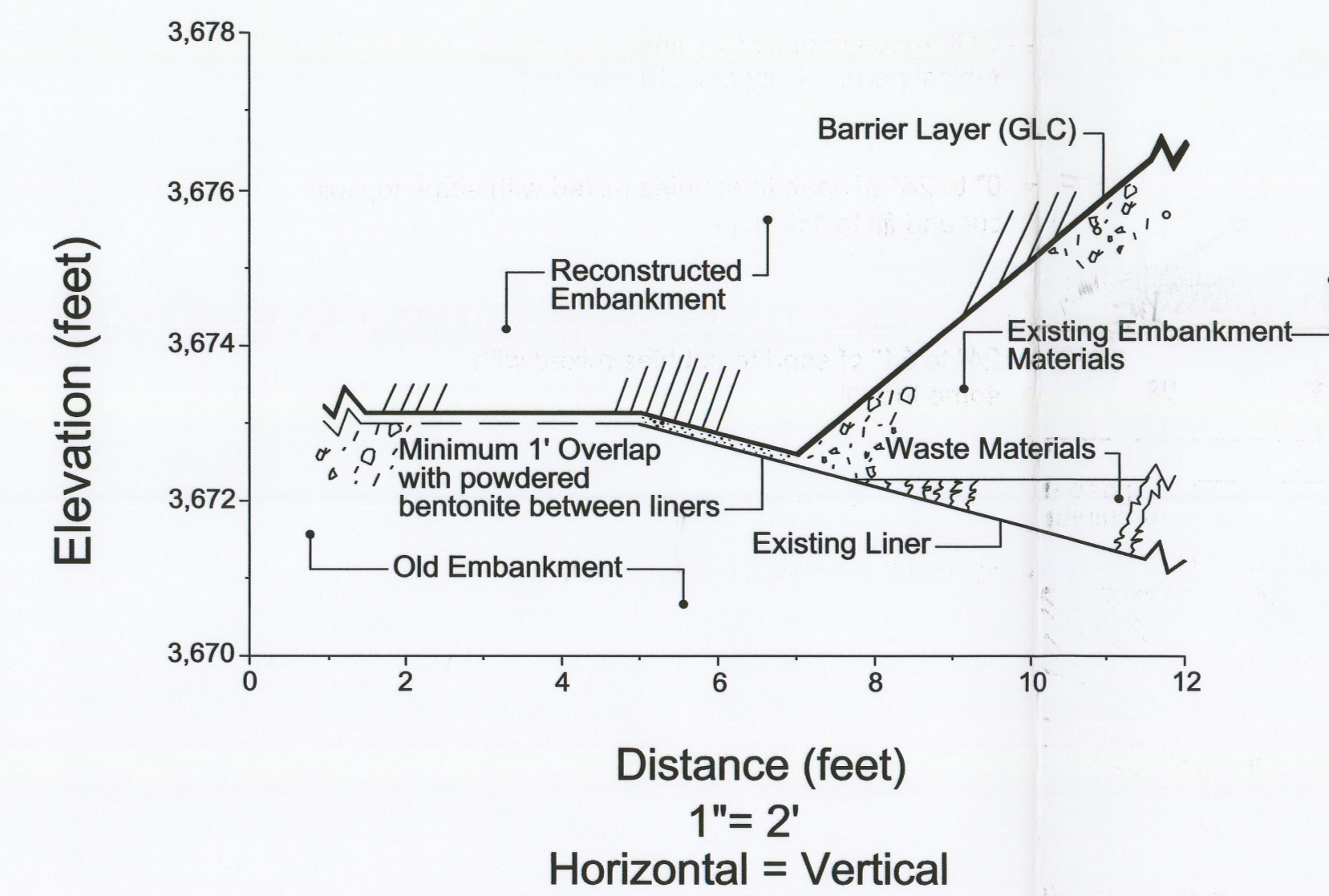
Selected Alternative - Cover Profile



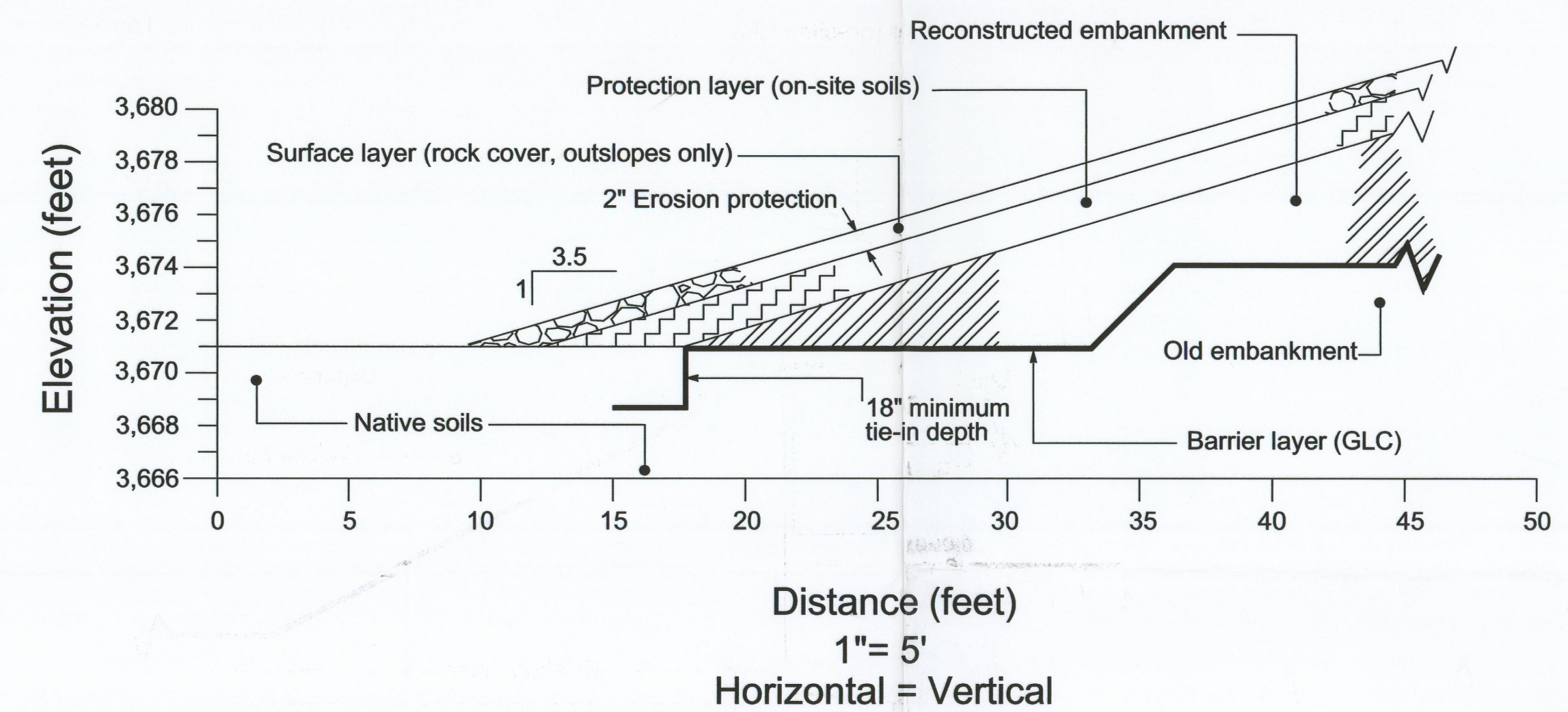
Reconstructed Embankment Profile




GLC to Existing Liner Tie-in Details

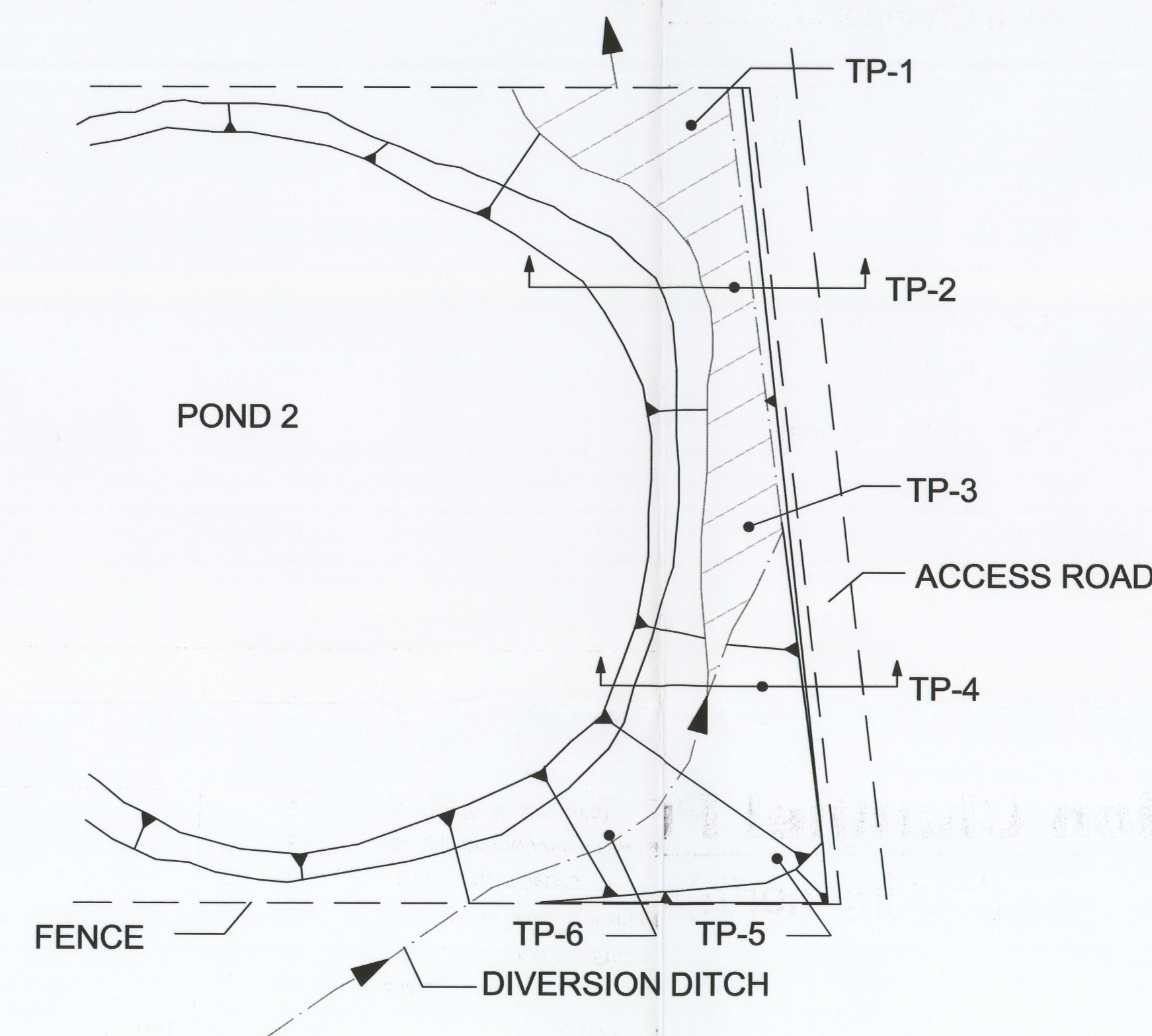


GCL to Native Soils Tie-in Details



REVIEWS	NO.	BY	CKD.	DATE	REFERENCES	DRWG. #	DRWG. TITLE	DESIGNERS	BY	DATE	<div><p>This drawing is the property of HECLA MINING COMPANY</p><p>This drawing is furnished for the sole use of the recipient and acceptance of same constitutes an agreement that it will not be published, reproduced or given to any other party without our permission unless furnished to recipient under contract provisions and shall remain the property of Hecla Mining Company subject to return on request.</p></div>	<div><p>PREPARED BY:</p><p>MONSTER ENGINEERING INC.</p></div>	<div><p>Apex Site</p></div>	TITLE: <div><p>Drawing 4</p><p>Cover System Details</p></div>	
						1	Site Layout		DES.	D.O.G.					6/03
						2	Pond 2 Plan View and Profile		DRAWN	OWS.					7/03
						3	Berm Layout and Embankment Profile		CKD.	D.O.G.					3/04
						4	Cover System Details		APPR.						
						5	On-Site Borrow Area & Diversion Channel Plan & Profile								
						6	Erosion Protection Detail								

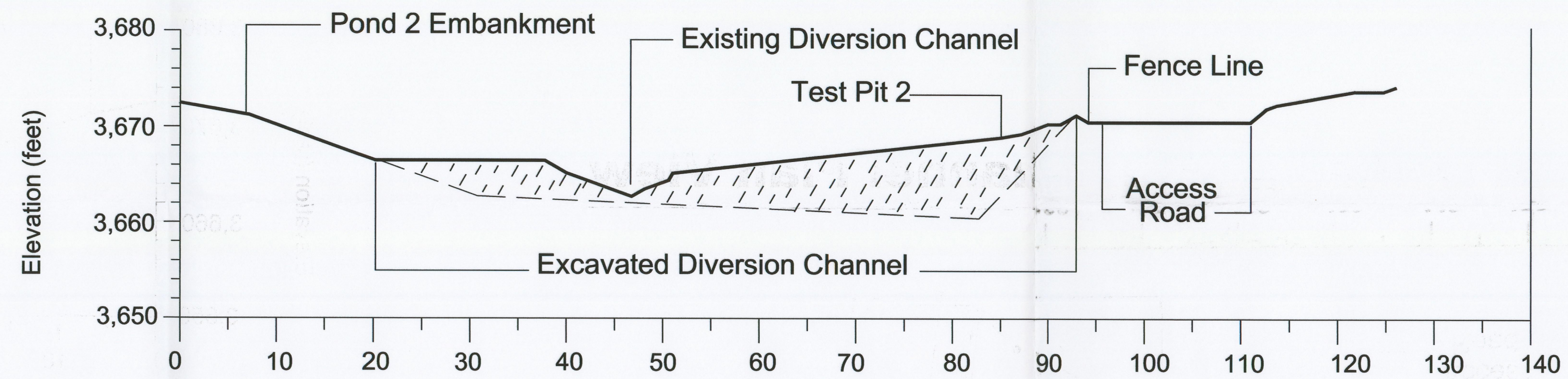
Borrow Area/ Diversion Channel Plan View



NOTE: TP-1 = Test Pit Number 1

Diversion Channel Profile at TP-2

(looking north)



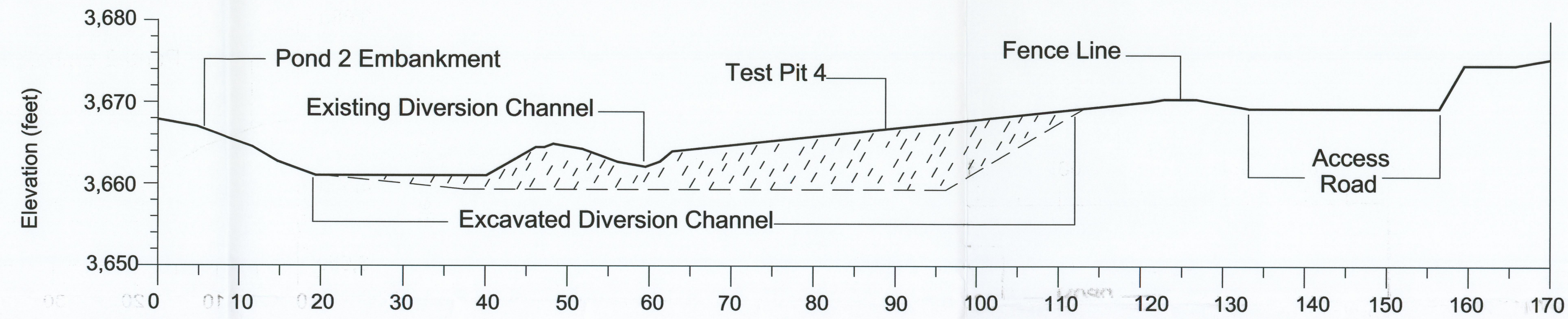
Distance (feet)

1" = 10'

Horizontal = Vertical

Diversion Channel Profile at TP-4

(looking north)



Distance (feet)

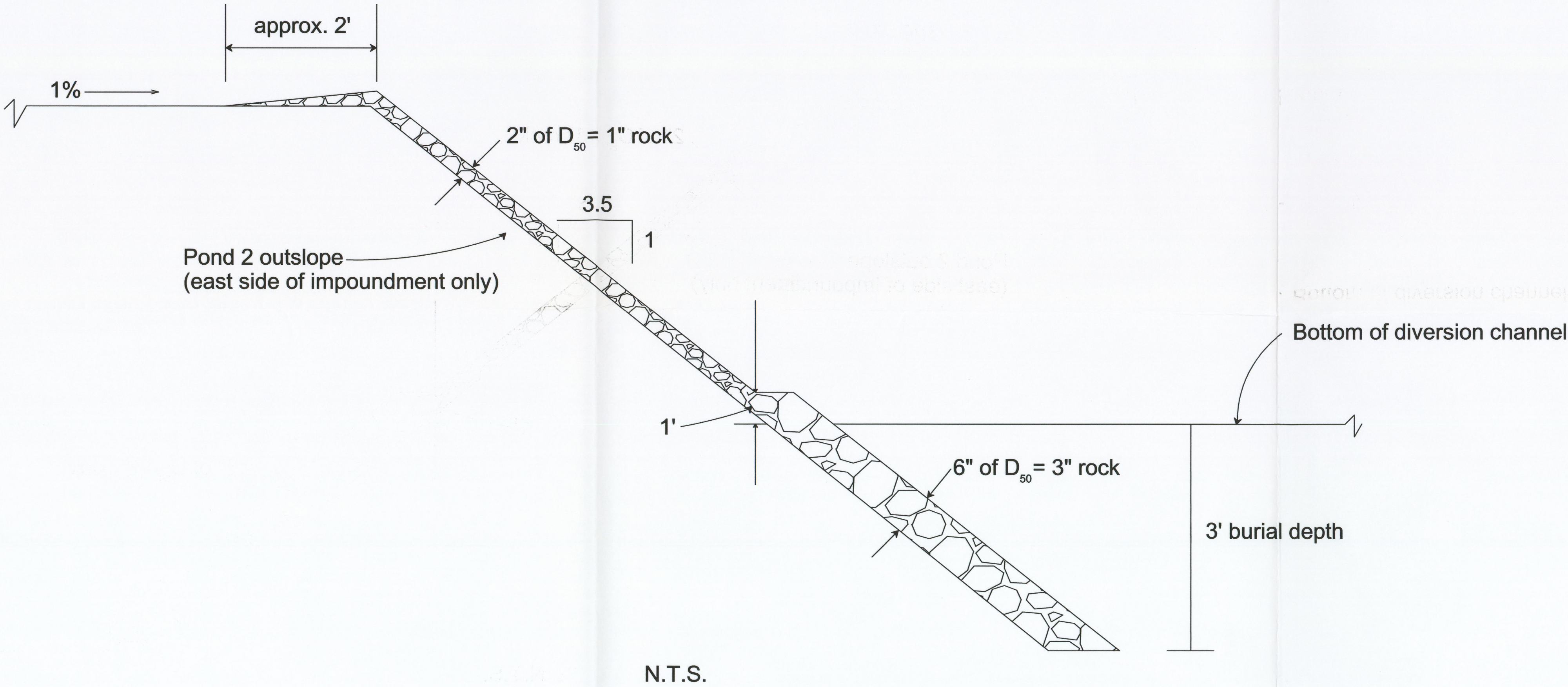
1" = 10'

Horizontal = Vertical

REVISIONS	NO.		BY	CKD.	DATE	REFERENCES	DRWG. #	DRWG. TITLE	DESIGNERS		BY	DATE	<div><div></div><div>Hecla</div><div>MINING COMPANY</div></div>	<div><div>This drawing is the property of HECLA MINING COMPANY</div><div>This drawing is furnished for the sole use of the recipient and acceptance of same constitutes an agreement that it will not be published, reproduced or given to any other party without our permission unless furnished to recipient under contract provisions and shall remain the property of Hecla Mining Company subject to return on request</div></div>	<div><div>PREPARED BY:</div><div>MONSTER ENGINEERING INC.</div></div>	<div><div>Apex Site</div></div>	TITLE:	Drawing 5 On-Site Borrow Area and Diversion Channel Plan and Profiles
							1	Site Layout		DES.	D.O.G.	6/03						
							2	Pond 2 Plan View and Profile		DRAWN	OWS.	7/03						
							3	Berm Layout and Embankment Profile		CKD.	D.O.G.	3/04						
							4	Cover System Details		APPR.								
							5	On-Site Borrow Area & Diversion Channel Plan & Profile										
							6	Erosion Protection Detail										

EMD-4590002
REVISED 8/1/0002

**Profile of Impoundment Outslope
To Diversion Channel**



- Notes:
- Extend $D_{50} = 3"$ rock 1' above and 3' below bottom of diversion channel at impoundment outslope toe.


REVISIONS	NO.	BY	CHKD.	DATE

REFERENCES	DRWG. #	DRWG. TITLE
	1	Site Layout
	2	Pond 2 Plan View and Profile
	3	Berm Layout and Embankment Profile
	4	Cover System Details
	5	On-Site Borrow Area & Diversion Channel Plan & Profile
	6	Erosion Protection Detail

DESIGNERS	DES.	BY	DATE
	DRAWN	OWS.	7/03
	CKD.	D.O.G.	3/04
	APPR.		



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**Apex
Site**

TITLE:
**Drawing 6
Erosion Protection Detail**

EWAN 4590002
FILED 07-11